VOL. 175 No. 1 JULY, 1951

AMERICAN Gas Journal

AUG 15 1951

THE LIBRARY OF CONGRESS SERIAL RECORD AUG 22 1951

Better Performance... Increased Capacities... Longer Life...

Want to cut measurement costs and increase revenue? Then look into *modern* tin meters as built by Rockwell. You'll find they have a host of exclusive design advances and mechanical improvements. These features give you better meter service, greater capacity, longer meter life. Performance-wise and dollar-wise Rockwell meters are your best tin meter buy. Bulletin 1020 will tell you why. Write for it today.

Rockwell
EMCO
TIN GAS METERS
MADE IN BOTH 5 LT AND 10 LT MODELS • CAPACITY RANGE FROM 150 CFH TO 500 CFH

ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.
Atlanta Boston Chicago Columbus Houston Kansas City Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

Pair them for Profit

go Rockwell all the way!

These two groups of Rockwell products are easing the burdens of gas distribution for many an operator. Their engineered durability and sustained precision have been proven for many years. Their *plus values* lie in service economies.

Consider Rockwell balanced valve regulators. They are *adaptable*—can quickly be re-sized to meet changing conditions by simply replacing the valve assembly through a hand hole while the regulator body remains in the line.

Rockwell meter internal assemblies lift from the bowl type body as a unit. The assembly can be replaced in the same meter body with a new or rebuilt duplicate that has been shop calibrated for accuracy . . . without further adjustment.

For service satisfaction and low cost maintenance ease, go Rockwell all the way. Write for bulletins.

ROCKWELL
MANUFACTURING CO.
PITTSBURGH 8, PA.

Atlanta • Boston • Chicago • Columbus
Houston • Kansas City • Los Angeles
New York • Pittsburgh • San Francisco
Seattle • Tulsa

ROCKWELL meters and regulators

AUG 15 1951

Now... a NEW BLAW-KNOX *Portable* FOGGER

FOR LOCAL DISTRIBUTING POINTS

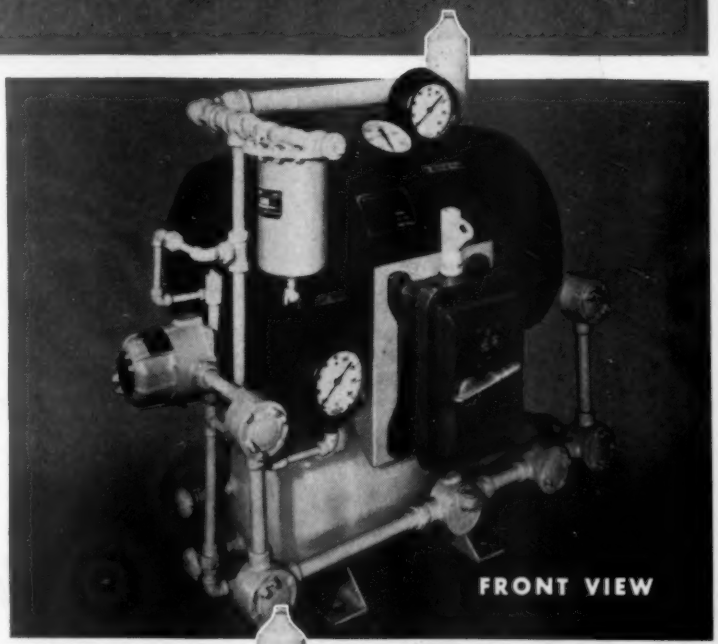
B 315164

Just the size for your smaller City Gate Stations and District Regulator Stations

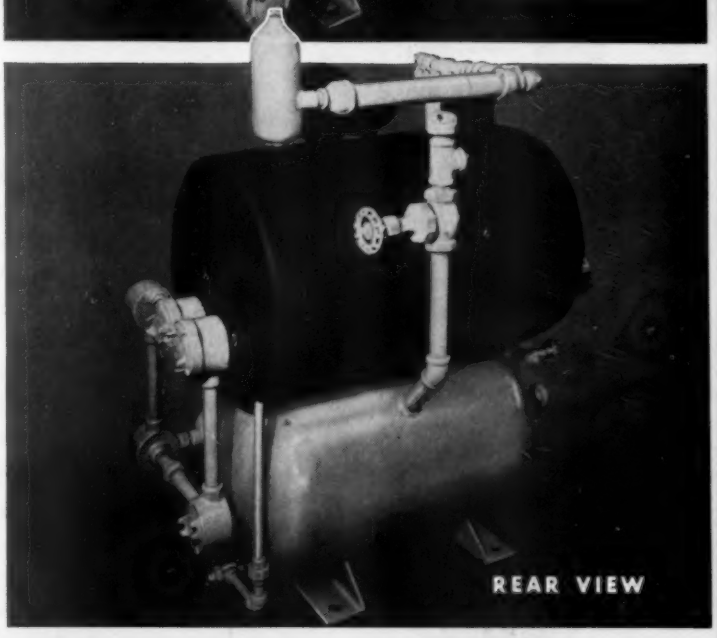
And like the larger Blaw-Knox Electroil Fogger, this new model is a *safe, explosion-proof, shop-assembled* unit which solves many natural gas distribution problems. The Portable Fogger produces a stable oil fog in the gas stream . . . safely, automatically and with minimum attendance or supervision. Being a shop-assembled unit it is ready to be connected "as is" to gas and electric power lines quickly and easily. For comprehensive data—

Write for Bulletin No. 2353.

1. **Simple to install.**
2. **Easy to operate.**
3. **Temperature control is completely safe and automatic.**
4. **Electrical equipment is explosion-proof.**
5. **It will produce a stabilized fog.**
6. **Wet down existing dust deposits.**
7. **Moisten leather diaphragm.**
8. **It coats inside of pipe with a protective oil film.**



FRONT VIEW



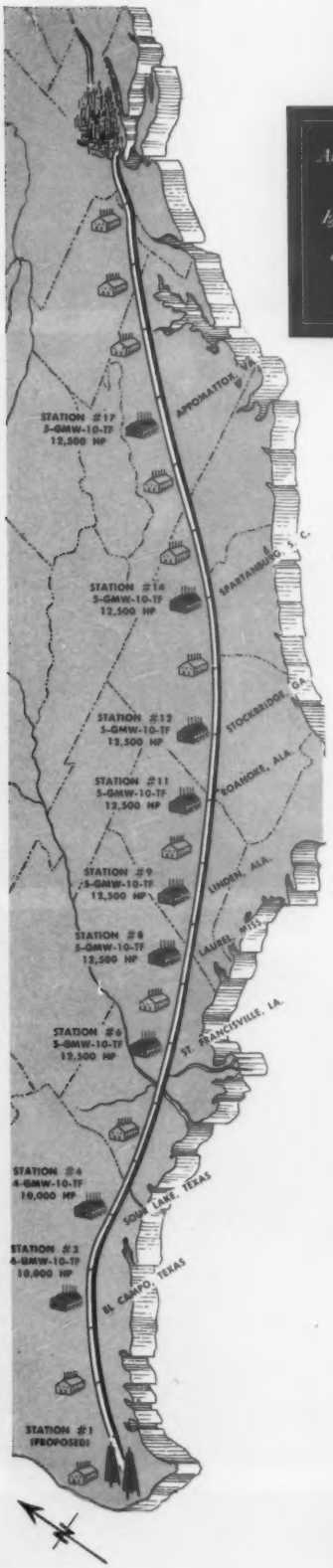
REAR VIEW

GAS EQUIPMENT DEPARTMENT

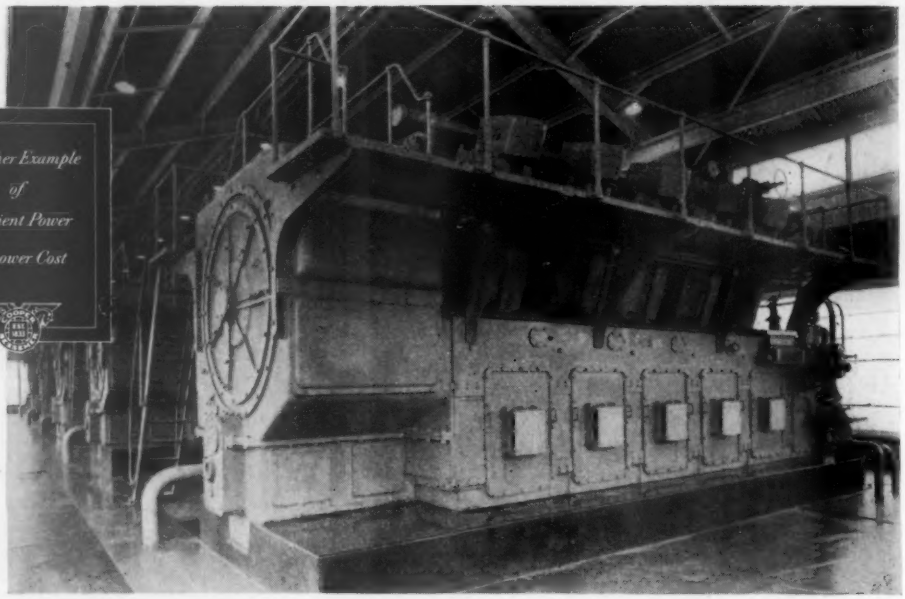
BLAW-KNOX DIVISION

OF BLAW-KNOX COMPANY

2061 FARMERS BANK BUILDING
PITTSBURGH 22, PA.



Another Example of Efficient Power at Lower Cost



This line-up of modern GMW's is duplicated in all of the Cooper-Bessemer-powered Transcontinental stations. In addition, 7 of the stations are each equipped with 3 JS-5, 375 hp gas engines driving generators for all electric power needs.

GMW's..."cutting corners" on the 1,840-mile Transcontinental Line

While the huge Transcontinental Line was still in the initial planning stage, news broke of a Cooper-Bessemer compressor engine development almost too good to be true. It was the now well-proved GMW — not only the most powerful, most compact "angle" compressor engine ever built, but utilizing fully the new Cooper-Bessemer high compression development, permitting fuel economies never before attained.

Fish Engineering Corp., responsible for the design, engineering and construction of the line, was quick to see that GMW's could save Transcontinental hundreds of thousands of dollars in installation, housing, cooling and piping costs and fuel consumption.

Today, as indicated on the system map, Transcontinental has 43 GMW's, totaling 107,500 horsepower, divided between 9 of the line's stations. These modern, dependable units are more than living up to expectations, just as they are on other important lines.

If your plans call for compressor horsepower, be sure to check on the latest Cooper-Bessemer V-angle developments. These units, GMW's, GMV's and GMX's are built in a complete range from 220 to 3000 bhp.

Cooper-Bessemer Powered Stations

Other Stations

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York, N. Y. Washington, D. C. Bradford, Penna. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and
Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La.
St. Louis, Mo. Los Angeles, Calif. Chicago, Illinois Caracas, Venezuela

AMERICAN GAS JOURNAL, July, 1951. Vol. 175, No. 1. Published monthly by American Gas Journal, at 73 Main Street, Brattleboro, Vt. Executive and Editorial offices at 205 East 42nd Street, New York 17, N. Y. Subscription prices: United States $3.00 per year; Canada $4.00; foreign $10.00; single copies 50 cents. Entered as second class matter January 24, 1950, at post office at Brattleboro, Vermont, under Act of March 3, 1879. Printed in U.S.A.

AMERICAN Gas Journal
ESTABLISHED 1859

VOLUME 175 JULY 1951 NUMBER 1

This month...

We are proud and almost a little nonplussed to be able to state that the 1951 Edition of *American Gas Handbook* is now in the hands of the printer; that it will have more new editorial material and more advertising pages than any edition printed in the last twenty years; that every paid up domestic subscriber to AMERICAN GAS JOURNAL will receive a copy as part of his subscription; and that if all goes as it should, copies will be in the mail by the end of July.

• • •

One of the little known ironies of publishing is that of receiving a letter from a manufacturer in the morning, commending the good old JOURNAL for its rugged editorial policy and urging us to give something or somebody plain unshirted hell, followed in the afternoon by a letter from an agency cancelling three or four pages of the same manufacturer's advertising schedule. Luckily we have had our Ivory Tower soundproofed so the moans of indignation and chagrin from the business office never get through to the editorial ears.

• • •

We have had some pretty glowing testimonials on the series, American Gas Fundamentals, and justly so we should say, but none that awoke quite the warm feeling of gratification evoked by a recent letter from an eighteen year old who is just rounding out his first year of employment with the Brockton Gas Light Company. "I have not yet even scratched the surface of this fascinating business," he writes, "but I know, with the fine help I get from you and the men I work with, I shall find my life work in this progressing industry." Our hat is off, too, to a company and to the fellow employees of a lad who can arouse in him such a measure of unadulterated enthusiasm for his job.

Contents

Editorial .. 9

Synthesis Gas from Pulverized Coal, Oxygen, and Highly Superheated Steam Is Produced in Pilot Plant—L. D. Schmidt .. 10

Compressed Air Drilling Replaces Trench Work in Laying Services—Edmond C. Powers .. 15

"Independent Contractor" Seems Sensible Solvent to Utility Problems—Leo T. Parker .. 17

Safety Is No Accident—Gordon L. Calderwood .. 19

Preparations for Natural Gas Changeover by Brooklyn Union .. 23

American Gas Fundamentals: Transmission of Natural Gas .. 29

Index of Yields: Selected Utility Stocks .. 33

Natural Gas Can Be Cleaned of Dust at Regulating Stations—Calvin A. Brown .. 34

News of the Gas Industry .. 38

Elliott Taylor • Editor

Howard F. Weeks • Associate Editor
Charles R. Bellamy • Technical Editor
Arthur Rohman • Western Editor **John F. Falvey • Financial Editor**

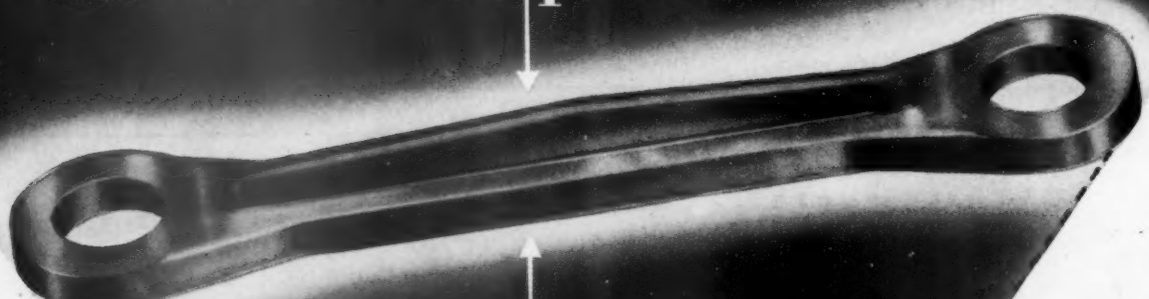
AMERICAN GAS JOURNAL, established 1859, is published monthly by American Gas Journal, Inc., 205 East 42 St., New York 17, N. Y. ROBERT M. POE, President and Treasurer; ELLIOTT TAYLOR, Vice-President; M. E. KELLEHER, Secretary and Assistant Treasurer.

ADVERTISING REPRESENTATIVES: JAMES C. MUNN, 2253 Delaware Drive, Cleveland 6, Telephone ERieview 1-1726; ARTHUR ROHMAN, 436 Douglas Bldg., Los Angeles 12, Telephone MAdison 6-0231.

Copyright, 1951, American Gas Journal, Inc., New York, N. Y.

Subscription Rates: United States $3.00 per year; Canada, $4.00; Foreign, $10.00. Single copies, 50 cents.

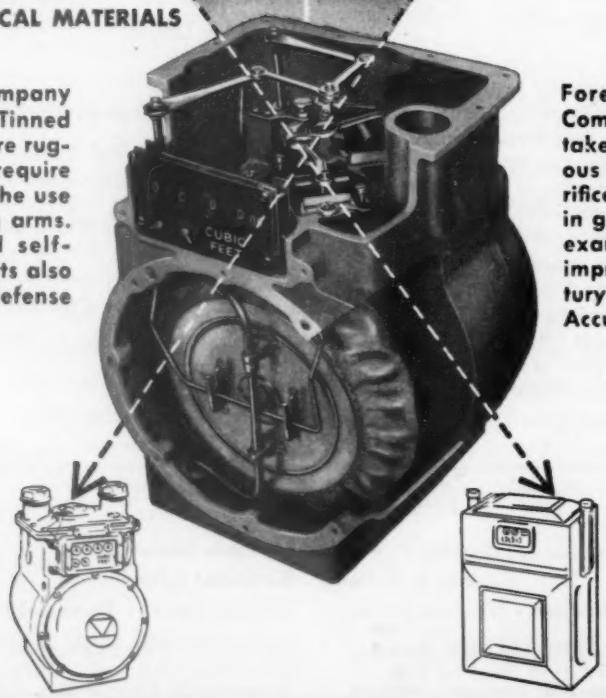
Another Improvement...



NEW NYLON FLAG ARM

- STRONG
- WEAR RESISTANT
- CORROSION RESISTANT
- CONSERVES CRITICAL MATERIALS

The American Meter Company domestic Ironcase and Tinned Steelcase meters are more rugged, last longer and require less service because of the use of these new nylon flag arms. Lighter in weight and self-lubricating, the new parts also save brass for critical defense production.



Foresighted American Meter Company engineers have thus taken steps to assure a continuous meter supply with no sacrifice of quality or performance in gas measurement — another example of constant product improvement to uphold its century old tradition of "Sustained Accuracy at Lower Costs."

GENERAL SALES OFFICE: 1513 Race St., Philadelphia
Albany • Alhambra • Amarillo • Atlanta • Baltimore
Birmingham • Boston • Chicago • Dallas • Denver • Erie
Houston • Kansas City • Los Angeles • New York • Odessa
Pittsburgh • San Francisco • Tulsa • Hamilton, Ontario

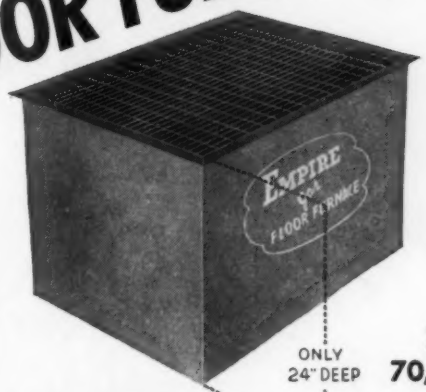
AMERICAN METER COMPANY
INCORPORATED ESTABLISHED 1836

Zone Control

WITH

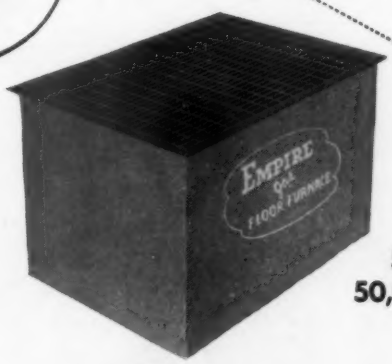
EMPIRE GAS FLOOR FURNACES

NO INTERNAL *Baffles* TO BURN OUT



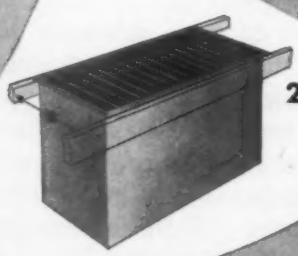
ONLY 24" DEEP

70-S-1
70,000 BTU



50-S-1
50,000 BTU

35-S-1
35,000 BTU



25-S-1
25,000 BTU

THE *Latest* IN MODERN GAS HEATING

Your customers will enjoy more comfort and lower operating costs when provided with a flexible heating system, enabling them to have different temperatures in the various sections of their homes.

An inexpensive, yet a highly satisfactory Zone Control Installation, can be accomplished by installing two or more Empire Floor Furnaces, individually controlled with Automatic Temperature Controls. Temperatures can then be controlled in the zone or section of the home in which each furnace is installed.

AGA APPROVED

EXCLUSIVE WITH EMPIRE

the FAMOUS

Gas BURNER

IT'S ENGINEERED, NOT ADAPTED FOR THE AVAILABLE GAS SUPPLY

EMPIRE STOVE CO. BELLEVILLE, ILL.

World's largest manufacturers of Floor Furnaces

Like a Percheron draft horse cast iron pipe is known for strength

Long life and low maintenance cost of mains laid under city streets depend not only on effective resistance to corrosion but on definite strength factors. The four strength factors that pipe must have to withstand beam stress, external loads, traffic shocks and severe working pressures, are listed on the page opposite. No pipe that is deficient in any of these strength factors should ever be laid in paved streets of cities, towns or villages. Cast iron water and gas mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe not only resists corrosion but combines all the strength factors of long life with ample margins of safety.

CAST IRON PIPE

in pipe for city streets

No pipe that is deficient in any of the following strength factors should ever be laid under paved streets.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

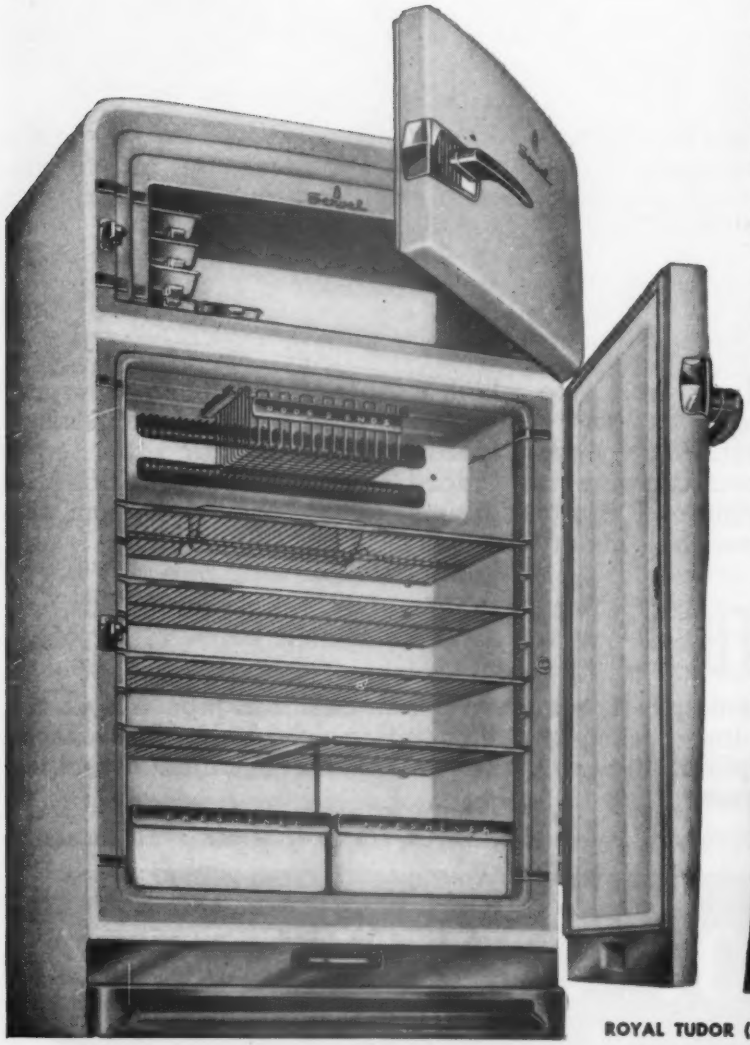
In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

SERVES FOR CENTURIES

Make this Summer your hottest Selling Season

Sell the Great New Servel



ROYAL TUDOR (Model BR-1118)

Hot weather will make warm friends and important sales for you this year with the spectacular new Servel. This incomparable refrigerator can really make sales history now, when summer heat and mechanical refrigerator breakdowns are making people replacement-minded. The new Servel is actually one-third bigger inside, yet needs no more space outside. And what's more, Servel's marvelous, motorless freezing system has a *10-full-year* warranty!

The magnificent Royal Tudor is truly the last word in modern refrigeration. Standard bearer of all eight new Servel models, it has a huge 11.5-cu.-ft. capacity . . . a separate 2-cu.-ft. freezer compartment and a 9½-cu.-ft. space for other foods. Homemakers will be sold by its feather-touch Bulldog Latches that click themselves shut . . . twin Dew-Action Vegetable Fresheners, glass-covered for easy visibility. Quick-Change shelves solve the problem of large bulky-food storage.

With the Royal Tudor and the other seven marvelous new Servels, you have a model for any size kitchen, any size family. So take advantage of the wide-open summer market to sell the world's finest refrigerator—the matchless new Servel. For suggestions write Servel, Inc., Dept. J-17, Evansville 20, Indiana.

STAYS SILENT . . . LASTS LONGER

Servel

The GAS Refrigerator

Editorial:

Codes and Conduct

THERE is no official seal of approval for industrial gas equipment such as exists for domestic gas appliances under joint American Gas Association--American Standards Association approval, commonly known as the Blue Star. The reason is that in most instances industrial gas-fired equipment is designed and built for the particular job to be done at the customer's plant, and every major installation has to be tailor-made to fit the requirements of the process in which it is to be used. It would be an almost impossible task to set up a schedule of requirements for every conceivable piece of industrial gas equipment.

Manufacturers and designers of this equipment, however, have become increasingly aware of the desirability of subscribing to and maintaining some recognizable and recognized standards. They want to set honest and ethical industrial gas practitioners apart from, and above, the in and outers who dash in from foundry, garage and sheet metal shop to scoop up a fast dollar on industrial gas installations, with their combustion engineering played strictly by ear.

To this end the Industrial Gas Equipment Division of the Gas Appliance Manufacturers Association has recently published a Code of Ethics (see page 22) which sets up certain ethical standards of manufacture, engineering and selling that all 35 members of that division have pledged themselves to adhere to.

This is a start in the right direction and so far it is highly commendable. Whether it ever amounts to anything will now depend on how the subscribers to the code make use of the opportunity that it presents them.

A code of ethics becomes meaningful only when those who are a party to it follow a course of action that embraces two major essentials: (1) they must all resolve severally as individual manufacturers that they will adhere strictly to its spirit in the conduct of their own business; and (2) they must devise and support ways and means to keep the existence of the code and the names of its subscribers actively before any industry or any segment of the public whose good will and confidence are being actively courted.

Without these two fundamentals the principles of the code become little more than a statement of pious platitudes, and its existence as meaningless as a framed copy of the Oath of Hippocrates in the reception parlor of an abortion mill.

Critical Scrap Metal

IN a communication fully documented by facts and figures, the American Iron and Steel Institute is currently urging all industry to seek out every available ton of scrap metal and place it in normal channels as quickly as possible, which means to sell it to the scrap metal dealers, in an effort to stave off the prolonged and critical scrap shortage now threatening our capacity steel production.

Supplies of heavy industrial iron and steel scrap are dangerously low. In the steel industry a 60 day supply of scrap on hand is considered the minimum margin for safe and uninterrupted operation. Now some companies have only a few days inventory, and are working from hand to mouth as short supplies trickle in.

The steel shortage is a very near and very immediate threat to the gas industry. In a recent address before the Kentucky Oil and Gas Association, C. P. Rather, assistant deputy administrator in charge of the gas branch of the Petroleum Administration for Defense, pointed out that for the third quarter of 1951 less than 517,000 tons of steel pipe will be available for gas transmission and distribution projects requiring 878,000 tons.

PAD is not satisfied with the quantities of steel that have been allocated to it by the Defense Production Administration. It proposes, in the words of Mr. Rather, "to argue vigorously that those quantities should be increased in the light of standards prescribed by the act." Whether this will result in the restoration of any cutbacks remains to be seen. There is little evidence to justify optimism at the present time.

But allocation of steel is one thing, and the delivery of pipe on the ground ready to lay is another. Obviously, if steel production is impaired through lack of scrap, or for any other reason, the gas industry will be further cut back, along with all others.

Over 80 per cent of the scrap consumed by the steel industry goes into openhearth furnaces, and practically all of the steel for line pipe is openhearth steel. Openhearth steelmaking calls for a charge consisting roughly of 50 per cent scrap and 50 per cent pig iron, as melters have found that greatest production efficiency results from this combination.

Allowing nothing for mill waste and croppings, application of the most elementary arithmetic shows that if the gas industry is to be delivered even its meagre 515,000 tons of pipe, that production alone will call for over 250,000 tons of scrap from some source, in the three months.

We would not venture a guess as to the amount of scrap iron and steel that a thorough cleanup job in the gas utility and the gas appliance and equipment manufacturing industries would produce. But, certainly there is no doubt about it, every available ton should be gathered together and disposed of immediately.

If the industry does stand a chance of improving its steel allocations either now or at a later date, what better evidence of good faith could it offer in presenting its case than a record of effective allout cooperation in the delivery of the essential scrap that may make that steel production possible.

Elliott Taylor

Synthesis Gas from Pulverized Coal, Oxygen, and Highly Superheated Steam Is Produced in Pilot Plant[1]

by L. D. Schmidt[2]

EXPERIMENTAL work on the gasification of pulverized coal with oxygen and with steam in three temperature ranges showed the following average requirements per thousand standard cubic feet of synthesis gas, consisting of carbon monoxide and hydrogen:

Steam temperature, °F.	Coal, lb.	Oxygen, SCF.	Steam, lb.
2,904	33.3	171	81.1
1,899	37.3	326	42.5
238	42.3	394	29.1

In general, the pilot plant performed very well, gasifying up to 450 pounds of coal per hour. The percentage gasification of the coal was also very satisfactory. The average percentage carbon gasified was 85 to 90. The oxygen requirement per unit of synthesis gas produced in the high-temperature steam runs was lower than for any other known continuous gasification process using oxygen.

Refractory materials, suitable for use in superheating steam to the extreme range of 2,700° to 3,400° F., were found to be available at reasonable cost.

The process developed indicates adaptability for the production of synthesis gas on a commercial scale. The type of coal used should not prove critical, so that apparently coal can be purchased on a heat-content basis. The process appears to be applicable to several industries where mixtures of carbon monoxide and hydrogen are desired.

Introduction

The Bureau of Mines, U. S. Department of the Interior, at its Morgantown, W. Va., station, operating under a cooperative agreement with West Virginia University, is conducting research and development work on the production of low-cost synthesis gas or blue water gas directly from raw coal. Use of raw coal instead of the coke employed in the usual water gas sets promises reduction of costs for synthetic-liquid-fuel plants. Synthesis gas, consisting essentially of carbon monoxide and hydrogen, can be converted by well-known procedures into gasoline, oil, pipeline gas, ammonia, alcohol, etc. The design of the pilot plant discussed in this report allows investigation of the relative advantages of supplying heat for the reaction of carbon with steam either by superheating the entering steam to a high temperature or by partial combustion of the coal with oxygen. The work described in this report is given in full detail in Bureau of Mines Report of Investigations 4733.[3]

Theoretical considerations indicate that the entrainment system of gasification developed in this pilot plant tends to be independent of specific coal properties, such as plastic range. However, ash-fusion temperature may prove important. The process consists essentially of blowing finely pulverized coal suspended in oxygen into a reaction chamber, where it mixes with highly superheated steam. The reacting mixture passes upward through the cylindrical reaction chamber with a swirling motion. After a residence time of three or four seconds in the reactor, which is at a temperature around 2,400° F., virtually all the coal is converted into the gases carbon monoxide, hydrogen, and carbon dioxide.

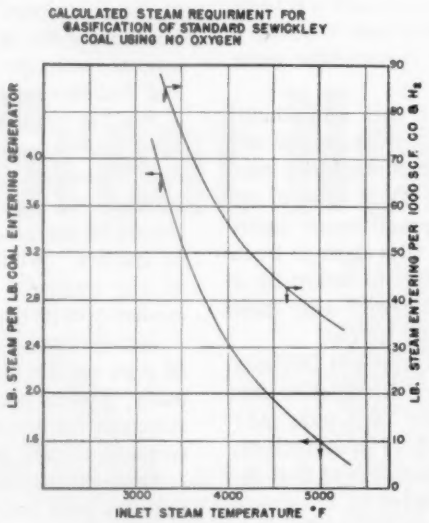

CALCULATED STEAM REQUIRMENT FOR GASIFICATION OF STANDARD SEWICKLEY COAL USING NO OXYGEN
LB. STEAM PER LB. COAL ENTERING GENERATOR
LB. STEAM ENTERING PER 1000 SCF. CO & H2
INLET STEAM TEMPERATURE °F

Fig. 1

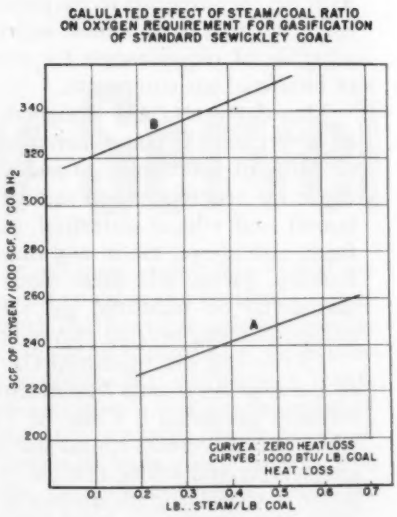

CALULATED EFFECT OF STEAM/COAL RATIO ON OXYGEN REQUIREMENT FOR GASIFICATION OF STANDARD SEWICKLEY COAL
SCF OF OXYGEN/1000 SCF OF CO & H2
CURVE A ZERO HEAT LOSS
CURVE B 1000 BTU/LB COAL HEAT LOSS
LB. STEAM/LB COAL

Fig. 2

HEAT SUPPLY

In general, the reactions of carbon dioxide and steam with carbon[4] to produce synthesis gas require that heat be supplied to the process.

Theoretical considerations indicate that heat may be supplied for the process by preheating the entering steam to a high temperature. Fig. 1 shows the calculated steam requirement (steam: coal ratio and steam: $(CO + H_2)$[5] ratio) for

[1] Work done in cooperation with West Virginia University. (Work on manuscript completed May 1951.)

[2] Chief, Synthesis Gas Branch, Bureau of Mines, U. S. Dept. of the Interior, Morgantown, W. Va.

[3] Strimbeck, G. R., Holden, J. H., Rockenbach, L. P., Cordiner, J. B., Jr., and Schmidt, L. D., Pilot-Plant Gasification of Pulverized Coal with Oxygen and Highly Superheated Steam: Bureau of Mines Rept. of Investigations 4733, November 1950, 41 pp.

[4] At 2,000° F:

$C + CO_2 = 2\ CO - 5{,}860$ Btu./lb. of C reacting.

$C + H_2O = CO + H_2 - 4{,}100$ Btu./lb. of C reacting.

[5] Gas volumes are given in standard cubic feet (SCF.) measured at 60° F., 30 in. Hg, dry.

various entering steam temperatures when all the heat for the strongly heat absorbing reaction of carbon with steam or carbon dioxide is supplied as heat in the entering steam. The analysis of the strongly coking Sewickley-bed coal used in most of the tests reported is as follows on the as-received basis:

	Per cent
Moisture	0.7
V. M.	35.7
F. C.	50.6
Ash	13.0
Carbon	71.1
Hydrogen	4.2
Oxygen	7.3
Sulfur	2.3
Nitrogen	1.4
	Btu./lb.
Gross heating value	12,770
Net heating value	12,360

Fig. 1 shows that, to supply all the heat for the reaction by means of the entering steam, either an excessively high steam temperature or an excessively large amount of steam is required.

Heat may be supplied for the process by the partial combustion with oxygen of coal or the volatile matter from coal. Calculations indicate that, when 240° F. steam is used, the oxygen requirement of the process is high, requiring as much as 340 cu. ft. of oxygen per thousand SCF. of carbon monoxide and hydrogen produced. Under these conditions the oxygen may be the most expensive ingredient per unit of synthesis gas produced. Fig. 2 shows the large effect of heat loss on oxygen requirement. The data shown were calculated for low-temperature steam (240° F.). The best method of supplying heat for the gasification process is the one that costs the least. An economic balance between heat supply as sensible heat of the entering steam and heat supply as heat from the combustion of coal with oxygen will determine the best operating conditions. The pilot plant was operated to learn experimentally the savings in oxygen obtainable by preheating the steam.

Description of Pilot Plant

The design of the gasifier is shown in Fig. 3. The inlet lines for coal and steam are tangential to a 24-inch-diameter circle, its center being at the center of the gasifier. By introducing the reactants in this way, the centrifugal forces caused by cyclonic action can cause the larger coal particles to be thrown to the generator wall, where they may be held by the slag while the reaction with the steam and oxygen is completed.

The refractory-lined generator has a steel shell 8 feet 6⅝ inches (O.D.) by 20 feet 7 inches high to the vent valve flange, and an effective internal volume

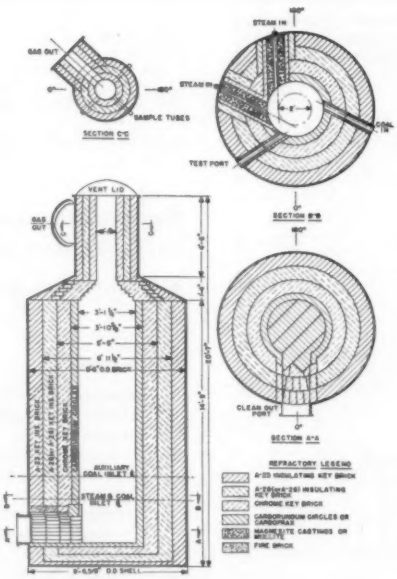


Fig. 3—Detail of Generator.

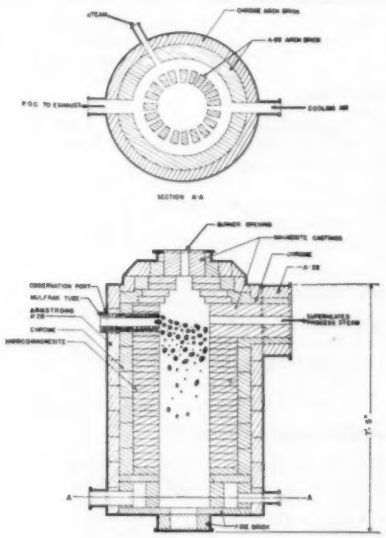


Fig. 4—Royster pebble-stove design used in runs 1-14.

of 86 cubic feet between the point of introduction of the reactants and the gas offtake.

Since a study of the use of high-temperature steam as a source of part of the heat supply for the process was also desired, the necessary equipment for producing extremely hot steam was designed and is shown in Fig. 4. This figure shows diagrammatically the construction of the Royster pebble stove, which produces highly superheated steam by passing the steam up through a pebble bed that has been heated previously to high temperature by the combustion of gas and air.

COAL FEEDER AND FLOW SHEETS

A new type of coal feeder that was especially developed for this work showed excellent performance. The coal-feeding system (Fig. 5) consists of two fluidizers—the first or batch feeder having a capacity of 1,000 pounds of coal and the second or continuous feeder, 150 pounds (later increased to 400 pounds). Pressure controllers maintain constant pressure within the fluidizers. The second feeder has enough capacity so that it can operate continuously while the first is shut down for charging. Investigations have shown that about 20 pounds of coal are conveyed through the feed lines by one cubic foot of air at normal working pressures and that the instantaneous coal-feed rate is directly proportional to the pressure drop across a given section of the feed line and independent of the discharge pressure if the oxygen flow and gasifier pressure are held constant. In operation, the instantaneous rate of feed to the gasifier is determined by reference to previously prepared calibration curves for coal flow versus the differential pressure as measured between the continuous feeder and the feedline sight glass.

The fluidized coal is fed through the coal-feed line to the sight glass (see fig. 5), and process oxygen is admitted at the sight glass. As the oxygen enters the funnel-shaped nozzle entrance, it carries the coal into the nozzle, and the mixture passes very rapidly through the tube into the gasifier.

DUST TRAIN AND FLOW SHEET

The dust-removal train (see Fig. 6) consists of a wet-type cyclone dust collector followed by three Aerotec-type cyclone separators, operated dry and each equipped with a hopper. From the last Aerotec the gas enters a sprayed standpipe and a standard wash box, such as is used on water gas sets. The gas, which still contains fine dust, is metered through a Roots-Connersville meter and then flared. Any material washed out in the wet cyclone and that entering the wash box from the sprayed standpipe is collected in a sludge tank. The overflow water from the sludge tank is metered over a weir and periodically sampled. Dust tests are run on the gas leaving the meter.

The use of water sprays of the fogging type in the wet cyclone was an expedient adopted to lower the gas temperature from approximatly 1,800° F. leaving the gasifier, to 400° to 500° F. entering the Aerotec collectors. In a large-scale plant a waste-heat boiler would probably be used for this purpose. In operation, a small amount of material is collected in this wet cyclone and washed to the

TABLE 1—AVERAGE RESULTS ON PILOT-PLANT RUNS

	High-temp. steam runs 1-14	Intermed. temp. steam runs 26-31	Low-temp. steam runs 15-25
Conditions			
1. Duration, hr	4.80	2.60	2.89
2. Raw-coal rate, lb./hr.	249.5	420	361.2
3. Process-steam rate, lb./hr	607	477	220
4. Process-oxygen rate, SCF./hr	1,288	3,672	3,270
5. Steam-inlet temp., °F.	2,904	1,899	238
Input ratios			
6. Steam/lb. raw coal, lb	2.48	1.14	.68
7. Oxygen/lb. raw coal, lb	.44	.74	.79
Synthesis-gas analysis, %			
8. CO_2	18.6	20.2	17.2
9. H_2	48.2	38.7	35.1
10. CO	27.1	38.1	43.7
11. CH_4 + Illuminant	2.3	1.1	1.9
12. N_2	2.8	1.5	1.3
Synthesis gas			
13. Outlet temp., °F	1,984	2,058	1,915
14. Gross heating value, Btu./SCF	273.7	260.5	280.1
15. Thousands of SCF./hr	10.00	14.73	10.70
16. (CO + H_2), thousands of SCF./hr	7.48	11.31	8.52
17. H_2:CO ratio	1.78	1.02	.86
Generator temp., °F.			
18. 4.5 ft. above floor of gen.	2,281	2,422	2,306
19. 11.5 ft. above floor of gen.	2,019	2,086	2,018
20. 16.5 ft. above floor of gen.	1,984	2,058	1,918
21. In horizontal outlet	1,837	1,832	1,803
Residue (dry basis)			
22. Lb./hr	46.7	46.2	71.8
23. Carbon, per cent	67.0	61.1	58.8
Ratios/1,000 SCF. (CO + H_2)			
24. Coal, lb	33.3	37.3	42.3
25. Oxygen, SCF	170.9	325.7	394.1
26. Steam introduced, lb.	81.1	42.5	29.1
27. Steam decomposed, lb.	18.1	8.0	8.1
Ratios/lb. raw coal			
28. Process oxygen, SCF.	5.20	8.75	9.40
29. Steam introduced, lb.	2.48	1.14	.68
30. Steam decomposed, lb.	0.55	.217	.193
31. Synthesis gas, SCF	40.7	35.1	30.6
32. CO + H_2, SCF	30.5	27.0	23.9
Carbon balance			
33. Total carbon in coal, lb./hr	180.4	297.1	257.1
34. Fixed carbon in coal, lb./hr	127.6	211.4	189.7
Based on measurement of gas volume:			
35. Total carbon in POC entering generator, lb./hr	5.3	15.7	—
36. Carbon in syn. gas, lb./hr	155.9	264.1	216.5
37. Ungasified carbon, lb./hr	24.5	33.0	40.6
38. Total carbon gasified, %	86.7	89.0	86.9
39. Fixed carbon gasified, %	80.6	84.7	82.2
Based on measurement of residue:			
40. Total carbon gasified, %	82.5	90.7	83.4
41. Fixed carbon gasified, %	74.9	87.2	77.4
Steam balance			
55. Undecomposed steam from hydrogen balance, lb./hr	480.5	388.4	157.2
56. Undecomposed steam from oxygen balance, lb./hr	462.9	383.6	160.6
57. Average undecomposed steam, lb./hr.	471.7	386 0	158.8
58. Total steam introduced, lb./hr	607.0	477.0	219.9
59. Steam decomposed, lb./hr	135.4	91.0	61.1
Computed equilibrium temperatures			
60. Shift reaction, °F	2,126	2,268	2,159
61. C–CO_2 reaction, °F	1,136	1,228	1,256
Heat balance, millions Btu/hr.			
62. Net heat of combustion of coal	3.107	5.028	4.420
63. Sensible heat in steam	.958	.449	.018
64. Sensible heat in POC gases	.072	.036	—
65. Total heat in	4.138	5.513	4.438
66. Net heat of combustion of gas	2.472	3.560	2.809
67. Sensible heat in gas	.513	.648	.437
68. Sensible heat in undecomposed steam	.471	.414	.148
69. Sensible heat of residue	.028	.037	.040
70. Net heat of combustion of unburned carbon	.368	.416	.588
71. Total heat out	3.853	5.075	4.021
72. Heat loss measured by heat bal	.285	.438	.417
Thermal efficiency			
73. Net heat of combustion of gas (Btu)/net heat of combustion of coal	80.7	70.9	64.6
74. Net heat of combustion of gas (Btu)/total heat in	60.1	64.6	64.3
75. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F./total heat in	79.5	81.2	75.7
76. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F. plus 70% of the heat of combustion of ungasified carbon/total heat in	85.4	86.4	83.4

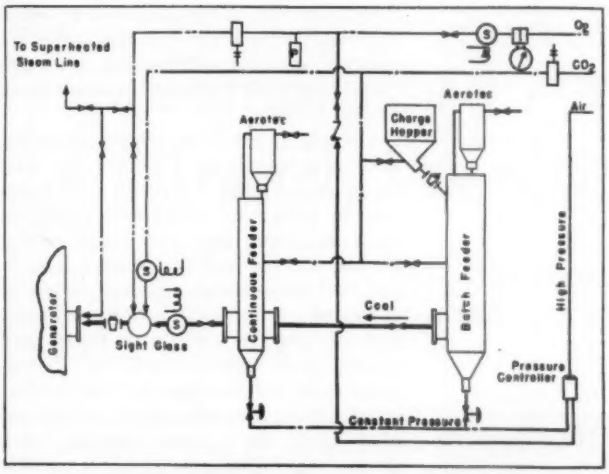


Fig. 5—Flow sheet for pneumatic coal feeder.

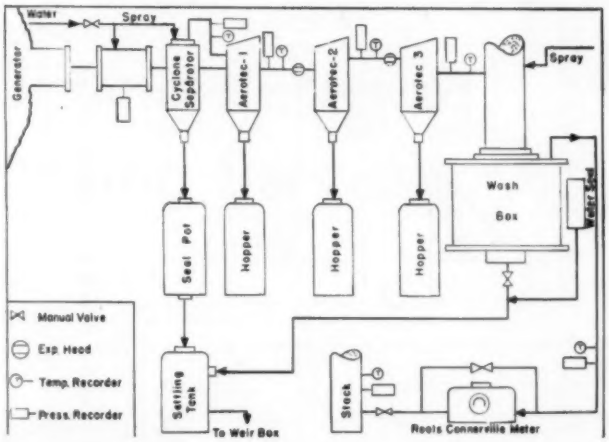


Fig. 6—Dust removal train used in runs 1-31.

sludge tank by a water stream in the base cone.

Operation of Pilot Plant

FIRST RUNS

During preliminary tests on the Royster pebble stoves, the top of the pebble bed in the stoves was held at about 3,600° F. for several months. Steam was thus heated to about 3,400° F. The tests showed that thermal efficiencies as high as 80 per cent could be achieved.

SUPERHEATED-STEAM RUNS (1-14)

Coal runs were begun using the procedure outlined below:

(1) The gasifier (or generator), vented at the top to the stack, was heated to approximately 2,200° F., as measured by a thermocouple extending about six inches into the reaction chamber at the 5-foot 9-inch level, over a 48- to 72-hour period.

(2) Preceding the run, the pebble stoves were heated to approximately 3,000° F. top pebble-bed temperature.

(3) Shortly after starting to raise the pebble-stove temperatures, 5-minute cyclic operation was begun, and steam was used at approximately the rate to be used during the gasifying runs.

The purpose of these three steps was to have the pebble stoves at nearly stable operating conditions as regards temperature gradients through the beds and to "soak" heat into the gasifier brickwork. Because of the limited gasifier heat-up burner capacity, it was not possible to preheat the gasifier higher than 2,200° F., although the temperature conditions near the end of the runs indicated that 2,400° F. would have been better. Consequently, during the early stages of the runs, heat was being added to the gasifier brickwork.

The usual temperature distribution throughout the unit for these runs (1 through 14) was as follows:

	°F.
Steam-inlet temperature	2,900
Coal and oxygen in at	atmos. temp.
Outlet cyclone	500
Outlet No. 3 Aerotec	425
Outlet wash box	190
Outlet meter	170

The Aerotecs were run at the temperatures shown to keep the collected dust as dry as possible.

All manometer lines were equipped for blow-back with carbon dioxide, to avoid being plugged quickly due to the dirty gas.

It was necessary during these runs to bypass the Roots-Connersville meter periodically and flush it out with water.

LOW-TEMPERATURE STEAM RUNS (15-25)

On completion of run 14, the condition of the pebble stove linings was such that they needed complete rebuilding. This need for rebuilding resulted from abnormal use of the stoves during the early work on testing of refractory pebbles and development of suitable operating procedures. The magnesite brick lining performed very well, considering the severe temperature changes to which it was subjected, and under usual operating procedures for refractory-lined equipment it has been shown that a very economical life can be expected.

During the period that a temporary superheater was being installed, a series of runs was made using steam at line temperatures—approximately 240° F. Steam from the main plant supply was put through a reducing valve and then through a steam-jacketed section of line to insure that it would be dry.

TESTS MADE USING STEAM AT 1,600° F. TO 2,000° F. (RUNS 26-31)

After the temporary steam superheater was completed, trial steam runs were made, and then gasifying runs made on Sewickley and Wyoming coals.

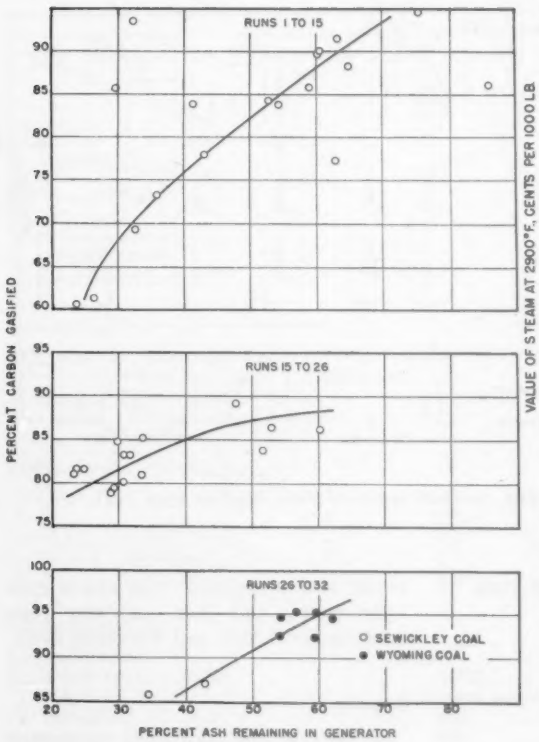
Results

In general, the pilot plant performed very well. Continuous operation was possible, and the runs were terminated voluntarily when the residue containers became full. The performance data that follow indicate that this process could, after further development, furnish low-cost synthesis gas on a commercial scale. The percentage gasification of the coal was very high and when high-temperature steam was used the oxygen requirement was lower than for any other known oxygen process.

AVERAGED RESULTS OF GASIFICATION RUNS

The average results of the gasification runs are presented in table 1, the first column being for the high-temperature steam runs, the second for the intermediate-temperature steam runs, and the third for the low-temperature steam runs. Before the results of a run were calculated, the data collected during the run were averaged with respect to time, and temperature and pressure corrections made where necessary. Gas samples were analyzed for CO_2, O_2, illuminants, H_2, CO, and CH_4. Residue samples were analyzed for moisture, volatile matter, fixed carbon, ash, and particle-size distribution.

Material balances on carbon are given in rows 33 to 41. Since synthesis-gas measurements for the first eight runs were inaccurate, results for these eight runs are based on residue data. Results beginning with run 9, when the Roots-Connersville gas meter was installed, are based on the carbon determined by the synthesis-gas measurement. Since the



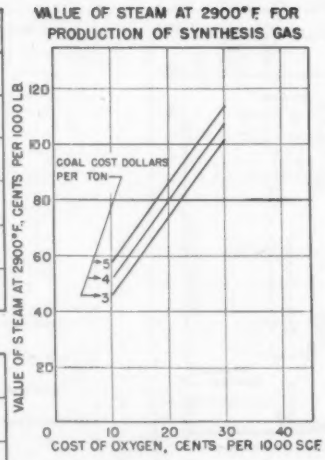

VALUE OF STEAM AT 2900° F FOR PRODUCTION OF SYNTHESIS GAS
COAL COST DOLLARS PER TON
VALUE OF STEAM AT 2900°F, CENTS PER 1000 LB
COST OF OXYGEN, CENTS PER 1000 SCF

Fig. 7 is at the left. It is a plot of total ash remaining in generator against percentage of carbon total gasified.

Fig. 8—Above.

measurements of moisture in the synthesis gas leaving the gasifier were of doubtful accuracy, the undecomposed steam in the synthesis gas was calculated as the average of the determinations from the hydrogen and oxygen balances.

Temperatures corresponding to equilibrium for the water-gas shift reaction and the carbon-carbon dioxide reaction are recorded in rows 60 and 61. Those for the water-gas shift reaction were found from the synthesis-gas analysis and the undecomposed steam by calculating the ratio $(CO_2)(H_2):(CO)(H_2O)$ and by using values of the equilibrium constant determined by the National Bureau of Standards.[6] Equilibrium temperatures for the carbon-carbon dioxide reaction were found similarly.

Heat balances on the process are presented in rows 62 to 72 and thermal efficiencies in rows 73 to 76. The net heat of combustion of the coal used was corrected for the sulphur present, since it is assumed that no SO_2 is formed. The heat loss as calculated from the heat balance compared fairly well with the heat loss calculated from conduction through the generator (gasifier) wall and from the rise in wall temperature.

ACCURACY OF RESULTS

Major emphasis in the work reported herein was on process development rather than the collection of accurate data; that is, more effort was put upon improvements in operability than in precise measurements. The test results shown in table 1 are the averages of many tests. The results of these tests were averaged, even though there was a very considerable range in process variables in the runs averaged together. For example, the average values shown for the intermediate-temperature steam runs include results using both Sewickley and Rock Springs, Wyo., coals. All other results shown are for Sewickley-bed coal. For the purposes of this report, averages are shown because rather high experimental error makes selection of "typical" runs somewhat hazardous. In spite of the range in process variables included in each average, the author believes that the averages show, with sufficient accuracy for present purposes, the major effects of large variations in steam temperature.

CONDITION OF GASIFIER

Examination of the gasifier at the completion of the runs showed that slag had not built up seriously at any point, the average depth of slag on the wall being about a quarter of an inch. This absence of serious slag depositions was a rather pleasant surprise, although the shortness of the runs could have been a factor.

In general, the silicon carbide lining remained good after a total of 56,000 pounds of coal throughout. Incipient failure of the Thermolith cement showed at the joints, however, the penetration being ½ inch in some cases. The condition of the silicon carbide tubes in which the water-cooled coal-injection tubes are inserted also remained good, although the Thermolith cement around them eroded badly.

On conclusion of the runs using steam at line temperature, 240° F., the wall areas surrounding the steam inlet tubes and the tube ends were found badly deteriorated from slag attack and probable reaction between the chrome and silicon carbide brick. According to correspondence, laboratory tests have shown that fluxing of silicon carbide and chrome brick will occur at 2,750° F. Deterioration of the magnesite tube probably was caused by slag attack, as test results made on a small furnace have shown rapid slag attack on magnesite brick at about 2,600° to 2,700° F.

Figure 7 shows the percentage of the total ash in the coal, which remained as slag in the gasifier and the percentage of total carbon gasified in each run. It can be seen that the percentage of ash remaining as slag increases with the percentage of carbon gasified.

Two factors observed in the operations of the unit indicate that very strong centrifugal forces are developed when tangential injection for the high-temperature steam is used. Ordinary thin-walled thermocouple protecting tubes are bent in the direction of rotation, and slag erosion where the Thermolith cement was used has been very extensive. At a steam rate of 800 pounds per hour and a temperature of 3,000° F., the velocity of the steam entering the generator is approximately 700 feet per second. The velocity of the coal-oxygen feed stream of course varies with the oxygen:coal ratio used, but is approximately 200 feet per second. Hence, the gases revolve inside the generator at a high rate.

DUST-REMOVAL AND RESIDUE DATA

Study of the data on the residue collected in the dust-removal train showed that the solid residue leaving the gasifier in the form of dust averaged about 20 per cent of the weight of the coal entering the gasified. About 20 per cent of the total dust leaving the gasifier was collected in the first Aerotec, and about 60 per cent showed up in the settling tank. The ash content of the solid residue leaving the gasifier averaged about 37 per cent. The screen analysis of the solid residue leaving the gasifier did not differ very significantly from the screen analysis of the original raw coal, which was about 90 per cent through a 200-mesh screen.

DATA ON SULPHUR CONTENT OF GASES

Because major emphasis has been on improvement in operability, it has not been possible to secure adequate check

(Continued on page 42)

[6] Wagman, D. D., and others, Heats, Free Energies, and Equilibrium Constants of Some Reactions Involving O_2, H_2, H_2O, C, CO, CO_2, and CH_4: Nat. Bureau of Standards Research Paper 1634, February 1945, 19 pages.

Compressed Air Drilling Replaces Trench Work in Laying Services

by Edmond C. Powers
Educational Director, Compressed Air and Gas Institute

THE practice which gas companies generally follow in using compressed air wherever possible to lighten the work load in laying gas lines has resulted in a widening number of uses for this power. A noteworthy example of this may be found in the way most West Coast gas companies have replaced much trench work by air drilling.

While the practice is common enough in the West, it has not yet been widely adopted in other parts of the country.

The problem of making a house connection by open trench may be visualized by referring to Fig 1. Looking out to the street from the new house, it may be observed that there is a large pile of dirt and concrete pavement between the house and street connection. In addition to work involved in cutting a trench, there is the matter of a traffic detour to consider, which comes more under the head of public relations than construction cost. By drilling with an air motor to make the connection the problems cited are removed.

The San Diego Gas & Electric Company, of San Diego, California, uses a multivane air drill for boring the pipe line connection hole (see Fig. 2). It is adapted so that water is admitted through the hollow shaft through the body of the drill, the water serving to soften the ground being drilled. Where the use of water is not permitted, such as under certain highway construction, compressed air jets are used in place of water for the softening as well as for driving the motor. In some cases water and air are combined for this purpose.

A fish-tail bit is screwed on the end of the drill pipe and a section of 1¼-inch guide pipe, which will not flex, keeps the drilling straight after bars are set to hold it in place. The air motor rotates the drill pipe used and drill. Where conditions permit, the entire length of the connection is set up in advance. If the working area is crowded, shorter sections are set up and later attachments connected as the work advances. When the hole is completed, the drill pipe is pulled out and the wrapped gas pipe shoved in, ready for house and street connections.

Fig. 1—Looking from new house to spot where men are standing in street shows the line an open ditch would follow for gas connections. It would involve cutting across concrete pavement and through a high pile of excavation dirt. Instead, a hole was drilled to the house by air motor.

Fig. 2—A multivane air drill is used for hole boring. The tool is adapted so water may be admitted through the hollow shaft of the drill body.

It is infrequent that rock or other obstacles are encountered to stop drilling, but when they are the drill is backed out and started over. There is more than ample power from the gas company's smallest air compressors, which are of 105 cubic feet per minute rating (see Fig. 3), to operate the air drill at 100 pounds per square inch pressure. The fact that compressed-air-operated drills are reversible facilitates work in hard soil or rock, where it is necessary to withdraw the cuttings.

Whether on house connections or larger pipe under highways and similar construction, the pipe laying cost is conservatively estimated as being half of the trench method. In many instances, however, the non-interruption of traffic is considered more important than any savings in construction costs.

The gas department of San Diego Gas & Electric Company uses 30 portable air compressors in its daily work. Of these, 24 are 105 cubic feet per minute capacity and six of 160 cubic feet per minute capacity. Most of the units are mounted on four wheels and the others on two wheels. The larger capacity compressors are assigned to jobs where a number of air tools are to be in operation at one time. The portable power set-up is flexible enough to meet virtually all working conditions. On the occasional larger pipe laying projects, the department will borrow larger compressors from other company departments. Portable compressors as well as tools are called in for regular inspection and overhauling. This routine keeps equipment at capacity performance and minimizes the need for major repairs.

The other uses for compressed air by the utility company in gas pipe laying work are numerous. Some of these uses might be mentioned. Air-operated sump pumps are used to squirt water to remove mud from pipe lines under busy San Diego Bay when the divers must get to these lines for repairs. The caulking tools used by the diver are operated from the same compressor and a separate compressor unit pumps air to the diver.

To some extent, every job performed presents different conditions and the flexibility of compressed air is a helpful factor in meeting these variations. Efficiency is further improved by the fact that pneumatic tool manufacturers have made available tools especially suited for varying conditions. An example of

Fig. 3—This 105 cubic feet per minute portable air compressor is typical of units used by San Diego Gas & Electric Co. for drilling and operating other pneumatic tools used in laying gas lines.

Fig. 4—Pneumatic clay diggers are used to ease many different digging jobs.

this is found in the use of pneumatic clay diggers (see Fig. 4), which are about half the weight of paving breakers yet effective for most digging operations. The gas company uses a range of spades with this tool from 1-inch up to 8 inches wide. The latter width serves well on such jobs as digging sod which is to be replaced. The narrower widths are effective with decomposed sandstone, adobe and other hard soil. By having the right tool and the right accessories, the company is prepared to efficiently dispatch whatever work is at hand.

When the gas industry first started to enjoy the benefits of compressed air in field work, the uses were largely confined to paving breakers. Always trying to find new uses for air because it is an easy and effective power to apply, applications have considerably increased since the earlier days. In addition to the applications which have been mentioned, other uses by San Diego Gas & Electric Company typify the general trend in the industry. Pneumatic back fillers, wire brushing for cleaning pipe welding between each pass, rock hammers for drilling hard ground or pavement when looking for leaks, lapping large pipe with air-operated drilling machine and similar other operations are powered from portable air compressors.

A compressed air use outside the field of tool operation is that of drawing off saturated gas under a pavement in case of an unlocated leak. Instead of a steam ejector, the company passes air over an orifice in a tube, which creates a vacuum in the tube to suck out the gas.

Much of the manual work in gas line laying has been removed by the use of compressed air in one way or another.

Gas Water Heater Shipments Are 25% Ahead of 1950

Shipments of automatic gas water heaters amounted to 168,800 in May, bringing the total for the first five months of this year to 1,040,200 units. This is 24.9 per cent higher than the 832,500 shipped in the first five months of 1950, according to Edward R. Martin, director of marketing and statistics, Gas Appliance Manufacturers Association.

The latest available figures on electric storage water heaters cover the first four months of this year, when 372,200 units were shipped, compared with 274,400 in the similar 1950 period. Four-months' shipments of automatic gas water heaters were 888,100 this year and 637,300 in 1950.

Personnel Conference Is Held At Kansas City

The AGA Midwest and Great Lakes Personnel Conferences at a joint meeting held in Kansas City, Missouri, on June 8, agreed to cooperate with the AGA Personnel Committee in sponsoring an industrial relations session at the 1951 annual convention of the American Gas Association at St. Louis, October 15 to 17. Chairman Harold F. Taylor of the employee relations group of the Southern Gas Association reported a belief that his group would join the others in sponsoring the proposed session at the Convention.

About 60 gas company personnel executives attended the joint session with J. T. Innis, vice-president of the Northern Natural Gas Co., and chairman, AGA Midwest Personnel Conference, presiding at the opening session. The meeting was addressed by Dwight S. Sargent, personnel director, Consolidated Edison Co. of New York, and chairman, AGA Personnel Committee; Norman D. Bradley, East Ohio Gas Co., and chairman, AGA Great Lakes Personnel Conference; and Kurwin R. Boyes, secretary of AGA. Mr. Taylor, Oklahoma Natural Gas Co., representing the Southern Gas Association, also spoke.

Mr. Innis pointed out that the conference offered the opportunity for personnel executives throughout the industry to become better acquainted with each other and to report and discuss developments. Mr. Sargent outlined the personnel activities of the AGA and emphasized the strong need for a close exchange of information in this field. Mr. Boyes, who also serves as convention manager of AGA, outlined convention plans with particular stress on the proposed industrial relations session.

Columbia Engineering Changes Name to CGS Service Corp.

Columbia Engineering Corporation, the subsidiary service company of The Columbia Gas System, Inc., changed its name to Columbia Gas System Service Corporation, Stuart M. Crocker, Chairman, announced June 21. He said the change was made because it more clearly reflects the function of the service company.

Blaw-Knox Awarded Contract By Bureau of Mines

Chemical Plants Division of Blaw-Knox Company has been awarded a $333,870 contract by the Bureau of Mines for the design and construction of a demonstration-scale retort for the continuous extraction of oil from shale. To be located at Rifle, Colorado, the plant will be able to process from 150 to 400 tons of oil shale daily. It will employ a new "gas-combustion" retorting process developed at Rifle by the Bureau.

'Independent Contractor' Seems Sensible Solvent to Utility Problems

by Leo T. Parker
Attorney at Law, Cincinnati

ACCORDING to a recent higher court, if a gas company sells a gas appliance and guarantees to keep it in operative condition, the company is liable for damages resulting from failure of its employes to keep the appliance in good and safe condition.

For example, in Finley v. Tennessee Gas Co., 231 S. W. (2d) 793, the testimony showed facts, as follows: The Tennessee Gas Co. installed in a store building a gas heater which the property owner named Finley alleged was defective. Finley notified the gas company of the defect, but the latter failed to correct or repair the defect, as a result of which gas escaped into the store building, causing an explosion which resulted in a fire, destroying the store building and contents.

Finley sued the gas company for heavy damages and proved these facts: Some time before the explosion and fire, Finley had purchased from the gas company a gas heater, which had been installed by the company's employes and connected with its gas main.

By the terms of the purchase contract the gas company agreed to maintain and "keep up" the heater at all times.

The explosion occurred in the early morning of the following Tuesday.

On Friday previously Finley called the office of the gas company over the telephone and reported to an employe in the office that the gas would not burn, that the heater would go out. The employe replied she would get somebody there as soon as possible. However, no one came, and on Saturday Finley called the office of the gas company in the morning and again in the afternoon by telephone and reported that the heater would not burn and the gas company's employe promised to send someone to fix the heater but did not do so. Every time Finley lighted the heater it would soon go out, and several witnesses testified that they had smelled gas. Finally a serviceman from the gas company came and inspected the heater which was operating properly at that time and he made no repairs.

In holding the gas company liable for $19,500 damages, the higher court said:

"If gas accumulated in the building by reason of the negligence of the defendant, it is not necessary for the plaintiff (Finley) to show how the gas became ignited to make out a prima facie case. To avoid liability in such case it is incumbent on the defendant to show that the damage was caused by some independent intervening agency for which it is not responsible and which it could not have reasonably anticipated."

The gas company could have avoided the heavy expense of this suit and $19,500 damage allowance, if its serviceman had (1) turned off the heater immediately after receiving the complaint that it operated improperly; or (2) if the serviceman had disconnected the defective heater and installed one not defective; or (3) if the gas company's employes had properly tested the gas heater before the installation and learned that the heater was defective.

Independent Contractor

Considerable discussion has arisen from time to time over the legal question: How can a gas company avoid liability for injuries to persons and private property resulting from negligent installations of gas appliances, gas lines, etc.?

According to a recent higher court the answer is: "Employ an independent contractor to do this work."

Modern higher courts consistently hold that there is a vast legal difference between a mere employer and an "independent contractor." Some courts hold that an employer is not required to pay taxes as social security, state workmen's compensation, unemployment compensation, and the like on an "independent contractor." Also, generally an employer is not liable in damages, or for payment of compensation, under the state workmen's compensation act, to an independent contractor killed or injured while performing his work.

And most importantly a gas company is not liable in damages for injuries to third persons or private property caused by an "independent contractor."

For example, in the leading case of Mercer v. Ohio Fuel Gas Co., 79 N. E. (2d) 685, the testimony showed facts, as follows: The Ohio Fuel Gas Co. is a public utility owning and maintaining a gas pipe line through a farm. The gas company was making certain repairs and improvements to its pipe line through the farm. These improvements consisted of taking up old pipe and laying new. The operation with reference to the new pipe consisted of brushing and cleaning the same, coating it with a thin coating of paint, welding the joints together, coating with a layer of enamel and relaying the same underground. The enamel used in coating this pipe was a coal tar preparation which came in metal drums. The contents were chopped into pieces with an ax, melted in tar kettles and while hot applied to the pipe. In chopping the tar from the drums pieces were strewn on the ground, and the hogs owned by the farm owner ate it and died. The farm owner sued the gas company for heavy damages.

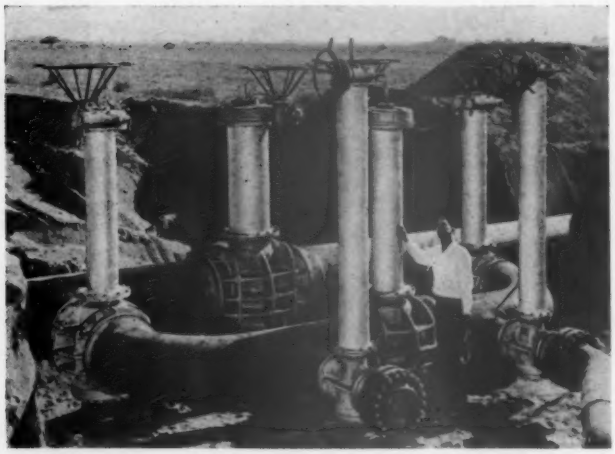
During the trial the gas company proved that a contractor, named Smith, had entered into a written contract with the company to perform all the work necessary for the removal and replacement of the pipeline. The gas company furnished the pipe, the local tar, the primer, and delivered these materials upon the farm. In addition the gas company did the welding and furnished an inspector to see that the work was properly performed.

In other words, Smith was an independent contractor who caused death of the hogs.

The fact that Smith was paid by the gas company on a contract basis, not on an hourly wage, resulted in the higher court holding the gas company *not* liable in damages to the farm owner. The court said:

"At the close of all the evidence the court instructed the jury to return a verdict for the defendant, The Ohio Fuel Gas Co., for the reason that there

VALVES READY TO GO UNDER GROUND



This unusual underground installation of Rockwell-built Nordstrom valves with elevated gearing is one of seven such arrangements on the newly operating 501-mile high pressure natural gas transmission line of Pacific Gas & Electric Co. between Topock, Ariz., and Milpitas, Calif. This photo is of a pressure-limiting station near Bakersfield. Pipe sizes shown are 12, 24, and 34 inches. The line by Jan. 1, 1952, will deliver 400,000,000 cu. ft. daily.

was no evidence establishing that it was liable for the negligence of Smith, an independent contractor."

Of course, the farm owner may recover damages from Smith, but the important point taught by this leading decision, for readers who desire to plan against damage allowances is: While an employer, as a gas company, is liable in damages for negligent injury to persons or private property caused by its regular employes, the employer is *not* liable for negligence of an independent contractor.

Damage Award Too Low

Considerable discussion has arisen from time to time over the legal question: Can a higher court refuse to accept a damage allowance of a jury when it believes that the damage allowance is too small.

According to a recent higher court the answer is "yes."

For example, in Gill v. Eakin, 33 So. (2d) 821, it was shown that a gas company contracted to furnish and install certain gas equipment in a private home. Sufficient pipe was not then available to complete the installation and connect the equipment. Hence the gas company employes failed to seal certain risers. When the property owner opened a door of a little room, about 7 o'clock the following morning, the residence was practically blown apart due to the explosion of gas seepage from the riser. The wife was horribly burned and, after lingering in great mental anguish and physical agony for approximately fifteen hours, she died at a hospital in a nearby town. The husband also was badly burned and hurt, suffered excruciatingly, and was hospitalized.

The husband sued the gas company for heavy damages. The jury awarded $10,000 damages. The husband appealed to the higher court and proved that he had paid total expenses for hospital, medical, and doctors' services, of $3,025.69. The higher court held that $10,000 damages was inadequate. The court said:

"We are convinced the compensatory damages awarded appellee were not adequate. . . . The judgment of the trial court is affirmed as to liability of appellant (gas company) for compensatory damages, but reversed and remanded for a new trial as to the amount thereof."

Quite obviously, this suit could have been entirely eliminated if the gas company's employes had (1) properly sealed the riser; or (2) had turned off the gas; or (3) if the person who performed the work had been an independent contractor.

Must Sue Separately

Recently a higher court rendered an unusually important decision holding that where a *plurality* of persons are injured by the same gas explosion, the fact that one injured person convinces the court that his injuries resulted from *negligence* of the gas company, and therefore he was awarded damages, this fact will *not* enable other injured persons to receive damages from the gas company, without a separate trial. This decision is important and in favor of gas companies, because, irrespective of one unfavorable verdict, the company always has opportunity to win subsequent suits.

For example, in Montgomery v. Taylor-Green Gas Co., Inc., 206 S. W. (2d) 919, it was shown that a gas company's serviceman installed a gas meter in a building. Soon afterward an explosion occurred seriously injuring several persons. One of the injured persons named Newcomb sued the gas company for damages and convinced the jury that the explosion was caused by the company's negligence in installing the meter. The court awarded Newcomb $13,675 damages. See Newcomb, 195 S. W. (2d) 307.

Later other persons injured by the same explosion sued the gas company for damages claiming that the court should, without trial, award them adequate damages because the court had already awarded damages to Newcomb since negligence of the gas company's employes who installed the gas meter caused the explosion.

It is interesting to observe that the higher court refused to award damages to other injured persons without another trial, saying:

"Be that as it may, the rule is that a judgment may not successfully be pleaded as *res judicata,* or as an estoppel where there is no identity, or at least privity, of parties in the same antagonistic relation. An estoppel must be mutual and cannot apply as against a stranger to a judgment, since one's rights cannot be determined without an opportunity to present his side of the controversy."

Shut-off Box Causes Injury

According to a recent higher court a gas company is expected to make regular inspections of shut-off boxes to discover and repair any and all dangerous conditions.

For example, in Wendegatz v. Kansas City Gas Co., 217 S. W. (2d) 269, the testimony showed facts, as follows: In a city street there is a space between the sidewalk and the curb in which there are earth and grass. In this space the gas company had installed a metal gas shut-off box. This shut-off box was located over a gas pipe leading into a private home and was for the purpose of enabling the gas company's employes to shut off the gas to the home if necessary. The service pipe was connected with one of the main gas line pipes.

One night one Wendegatz parked his automobile along this curb. As he was in the act of stepping from the sidewalk into the parkway, his foot came in contact with the gas shut-off box causing him to fall breaking his knee cap and resulting in other serious injuries. Wendegatz sued the gas company for heavy damages. The counsel for the gas company argued that it could not be liable because the height of the gas shut-off box was due solely to rains during the summer washing away the ground from the box.

The higher court refused to agree and held the gas company liable in damages for injuries to Wendegatz and said:

"The cause of the dangerous extension of the box is not the gravamen of the case; it is the fact that it did extend

(Continued on page 46)

Safety Is No Accident

by Gordon L. Calderwood
Rochester Gas & Electric Corp.

JUST how safe is the gas industry compared with other great American industries?

National Safety Council figures for 1949 reported the gas industry No. 34 out of a list of 41 industries. In 1949 we sustained 17.92 lost time accidents per million manhours worked, a 10 per cent improvement over 1948, but that figure of 17.92 compares with *4.96* for the steel industry.*

Has steel always had such a record? Far from it. Fifty years ago undertakers fought for locations near the entrance of steel mills in South Chicago. By contrast, a recent statement issued by Bethlehem Steel Co., reported 17,000 men working last year with only 22 lost time accidents. Men in these plants today are actually safer on the job than away from it.

How are we doing? Last September the AGA Accident Prevention Committee reported that 36 companies had made a reduction of at least 25 per cent in both frequency and severity rates. One hundred companies made a 25 per cent reduction in at least one of these classes.

Numerically, the greatest number of accidents to employees are due to causes common to many industries: handling materials, slipping, falling objects, etc., causes which it is the duty of management, the safety department, and line supervision to reduce to a minimum. Reductions are possible by considering safety as an element in plant layout, by frequent inspection, by prompt remedy of unsafe conditions, by proper employee selection and training and the constant cultivation of safety attitudes in the mind of each employee.

A few mechanical hazards within our own industry merit special attention.

Conveyors

Hands and arms have been crushed, yes, and heads too, when men have tried to work around moving conveyors. If we are to eliminate this source of lost time accidents, we must insist that belts are shut down while men are cleaning up under pulleys and idlers.

Starting Equipment

A serious accident this past year pointed again to the need of labeling electric switches clearly—of the master mechanic, electrician, or other responsible person locking a switch in the 'off' position while men are working on the equipment served.

Power Tools

Only qualified employees should be permitted to use such potentially dangerous tools as portable grinders and portable power saws.

The use of protective clothing, including safety shoes, goggles, and gloves is as necessary in our industry as in any other. Clean clothing is also important to avoid the possibility of dermatitis.

Now, what are the hazards generally considered to be peculiar to our industry?

The Asphyxiation Hazard

First we will discuss the hazard of asphyxiation by CO. While a possibility wherever fuels are burned, it is peculiarly present where gases of high CO content are manufactured—producer gas 26 per cent, coal gas 12-15 per cent, water gas 33 per cent, reformed natural gas 13-16 per cent. Leaks in the generating apparatus, plant piping, purification equipment, pumping and distribution systems result in dangerous concentrations of CO in the neighborhood. Many leaks become increasingly evident as higher throughputs result in higher pressures throughout the plant. Recaulking of joints is now being superseded by mechanical clamping. Where mains formerly ran beneath plant buildings, it is wise to consider rerouting.

Around water gas machines, supervision must continually check to see that there is adequate ventilation. Operators are reluctant to open windows in cold weather. Leaks around generator clinker doors and coaling branch lids can easily result in dangerous CO concentrations.

Apparatus for quick and accurate determination of CO concentrations was developed during the war. Every manufactured gas plant needs some form of apparatus for quick, accurate determination of CO. Present detectors are inexpensive, sensitive to five parts per million (ppm) and give a ready check of the atmosphere in equipment removed from service for overhaul, in confined areas; such as the exhauster house, meter house or compressor building, and in underground electric or regulator vaults.

The American Standards Association recommended 100 ppm as the arbitrary upper concentration in which a man should be permitted to work. The color chart furnished with the tester indicates not only the CO concentration, but also the effects to be expected after prolonged exposure.

Fires in fuel bins are potential killers and must be handled with great care. A high CO concentration is certain to exist above a bin in which a fire is in progress. Even though the area is partly ventilated, a gas mask should be worn by anyone attempting to control the fire from above. Where there is a possibility of hot coke getting into a bin, it is wise to install water sprays above the bin. These may be turned on without the need of a man entering the dangerous area. Of course, a drain must be installed to prevent freezing of the system in cold weather. Our company recently experienced local spontaneous heating in a bunker of crushed coal. CO_2 was introduced at the throat of the bunker as the coal came down into the pulverizer. Oxidation was thus controlled, and the coal kept below the ignition point. With serious bunker fires it is occasionally the best solution to empty the bin.

Gas masks have continually improved. Hose masks with hand or motor-driven blowers are in general use. Oxygen breathing types; e.g., Scott Air Pak, Chem-ox have been developed.

Even though a man may not have been made quite unconscious by CO, he should have medical attention. Oxygen

Paper presented at Production Conference, AGA, May 1951.

* Rubber—5.10, Cement—5.18, Chemicals—5.72, All ind. ave. 10.54, Coal mining—41.48, Lumber—47.72

breathing apparatus is helpful. The man must be given rest. We cannot overlook the possible complications of heart strain with sudden exertion following absorption of CO by the blood.

In making repairs on equipment that has been purged, the apparatus must be blanked off or otherwise physically disconnected from the system. Also, all other sources of possible leakage of gas into the apparatus should be disconnected, such as gauge lines tied in common with gauge lines on other equipment. The original check for CO made before men enter the equipment should be followed by further checks at periodic intervals until the repairs are completed.

Fire Hazard

Few wood structures are found in gas plants today. Where such exist, insurance rates dictate the installation of automatic sprinkler systems.

Where fuel oil, tar, by-product light oils and LP fuels are processed or stored, adequate fire fighting equipment should be on hand. CO_2 gas and dry chemical extinguishers are finding increasing favor. Totally enclosed motors, explosion-proof switches and vapor-proof globes have long been considered essential. Smoking is prohibited in many plants except in prescribed smoking areas. This last is particularly critical when new, temporary, or contractors' men are working on the premises.

How long is it since electric wiring was inspected? Corroded conduit, junction boxes with covers gone, are invitations to short circuits.

The advantages of portable welding outfits in repairing coke chutes and other corroded structures have made the welder a member of the regular maintenance crew. Many of our "mechanics" are "torch happy." How often have we seen a bit of burning rag or waste where particles of hot slag have fallen on it —perhaps from the floor above. The lads who make our repairs are good kids. They just haven't been taught the need of the many safety precautions required when we use burning and welding techniques. What are some of these precautions?

1. Tack the ground electrode directly onto the work or so near to it that there is no question of good electric conduction.

Too often when a small patch job is to be done on the second floor, the ground electrode has been spotted to the column nearest the welding machine. As long as the welder can establish an arc he is happy. It matters not to our young Romeo that part of that circuit is a glowing, arcing bit of scale somewhere under the floor, perhaps in the neighborhood of a gas leak not yet recognized.

AGA REPORT SHOWS IMPROVED ACCIDENT EXPERIENCE

The gas utility industry in the United States had 16.03 disabling injuries per million man-hours of exposure in 1950, according to the report just issued by the bureau of statistics of the American Gas Association. This was 10.5 per cent lower than the previous year and marked the third successive yearly decline in the frequency rate. The number of disabling injuries per 100 employees declined from 3.70 in 1949 to 3.33 in 1950, a decline of 10 per cent.

The 1950 severity rate for the gas utility industry was 20.2 per cent lower than the 1949 rate and was the second lowest rate recorded since 1929. The number of days charged to disabling injuries per hundred employees decreased about 19.6 per cent and was the lowest rate recorded since data have been collected.

The number of disabling injuries per million man-hours in the natural gas branch advanced 1.6 per cent to total 15.46 in 1950. The corresponding rate for the manufactured and mixed gas branch of the industry was 17.32, a decrease of 23.8 per cent from the 1949 rate. The accident severity rate for the natural gas branch declined 10.3 per cent in 1950 compared with 1949, while the severity rate for manufactured and mixed gas companies showed a decrease of 31.9 per cent from the previous year.

2. A water hose and/or chemical fire extinguisher should be nearby, and the surrounding area well wet down. If dust is present, it should be flushed away or the job scheduled when the process responsible can be shut down.

The following precautions appear in American Standards for Fire Prevention and Protection:

3. Where practicable, move the object to be welded to a safe location designated for welding.

4. If the object to be welded cannot readily be moved, all movable fire hazards in the vicinity shall be taken to a safe place.

5. If neither of the above is possible, then guards shall be used to confine the heat, sparks and slag and to protect the immovable fire hazards.

6. If none of the above precautions can be carried out, the welding or cutting shall not be performed.

Again we must check the atmosphere for combustible gas before striking an arc, and we must check again at frequent intervals.

To combat fires that have started, an assured emergency water supply is essential, as is also plenty of fire hose, *on the hose cart* and ready for action. Frequent inspection of fire extinguishers and hose is essential. Actual working fire drills with fires in isolated locations have undoubtedly been neglected since the last "emergency" but are being reactivated. The signal to be used in case of fire should be thoroughly understood and frequently tried.

Safety in Operation of Liquefied Petroleum Gas Plants was discussed by H. Emerson Thomas at last year's Production Conference. He stressed the importance of thorough employee training in handling liquefied petroleum products.

The third hazard is the explosion hazard.

For an explosion, as for a fire, three conditions are, of course, necessary—a combustible substance, a source of ignition, and air. Eliminate any one and an explosion is impossible.

Explosions produce the most spectacular, the most costly single accidents, costly both in injury to persons and damage to property. Aside from the physical agony attendant on severe burns, scalds and contusions, it is impossible quickly to replace much of our equipment today.

Some plants are regularly checking exhauster, meter, and compressor houses for gas leaks. Stuffing boxes on boosters, packing on valve stems, and in bell and spigot joints are all common sources of leaks. Holes rusted in drip lines—and why do they always occur inside foundation walls—are sometimes to blame for the presence of gas in our buildings.

Our electrical equipment is all up to standard, we don't permit smoking. Are there any possibilities for ignition that we have overlooked? How about static electricity? It has long been the practice to ground gasoline tank trucks. How about grounding the discharge end of steam hoses used for purging scrubbers, or tanks of volatile oils. Hoses used in sand blasting or in applying "gunnite" throw a terrific wallop—better ground them. Observe such a hose operating in the dark for a few seconds if you need additional conviction.

The alternate contact and separation of dry leather or rubber belts on pulleys causes a static charge to accumulate on the belt. A grounded metal comb-type static eliminator will draw off such a charge. The danger of static discharges is greatly lessened when the humidity is above 70 per cent.

The inside of foul gas mains and apparatus ahead of the H_2S purification plant are frequently coated with deposits containing finely divided F_eS. If the

main is opened up for any purpose, air enters and immediately the F_eS begins to oxidize. If not kept moist it will rapidly dry out and begin to glow. We are really inviting trouble if we fail to purge foul gas equipment with steam or inert gas before removing it from service.

Combustible gas indicators are a great aid in detecting and pin pointing small leaks. The use of N_2 and CO_2 for purging natural gas lines and LP equipment is now wide-spread.

When a large container is to be purged, the annoyance of freezing encountered in the discharge valve of CO_2 cylinders can be overcome by attaching a copper tube of 3/16" id from the valve to the tank being purged. By preventing expansion until the liquid CO_2 has entered the container, it is possible to empty a 400 cu. ft. cylinder of CO_2 in three minutes.

There Is Air in Water

In 1942 an explosion occurred in a water gas condenser where gas from this condenser was used for underfiring coke ovens. A search was made to discover how air had entered the system.

The water gas set had been shut down for 39 hours preceding the explosion. In the meantime, water running into the wash box had entrained sufficient air to fill much of the piping and condenser. When underfiring was begun, this air mixed with gas reached the hot brick in the coke oven regenerators. Ignition proceeded back through the lines into the condenser. The latter was blown outward.

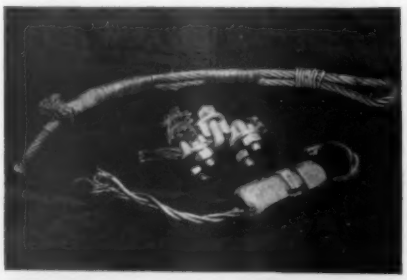
Tests made on the wash box showed that water entering at a rate of 2000 gals./hr. had introduced air at a rate of 160 cu. ft./hr. While other steps were taken in this particular case to prevent a recurrence, two are applicable to all water gas plants: 1—The water inlet funnel was modified to allow for the escape of any air previously entrained, and 2—It is now company practice to flood the wash box and close the gas valve even for brief shut downs.

A hazardous condition can arise in connection with the 3-way valve on water gas sets equipped for backrun. If the hydraulic cylinder is slow in operation, if a shaft key becomes loose or the shaft breaks, blow air from the base of the generator can pass through the backrun line through the wash box and mix with gas in the condenser and relief holder. When the CO_2 content of the mixture reaches 4.5, all that is needed for a disastrous explosion is the source of ignition. In several cases, this source has been a spark in the Cottrell precipitator.

It is now safe practice to interlock hydraulically the three-way valve and blast valve so that the latter cannot open until the former has closed. A butterfly damper in the backrun line, shut during the blow period, is also helpful. Oxygen recorders are now available and such an apparatus after each gas machine, especially when equipped with an audible alarm, is a good investment. When the clinker zone in the generator has progressed upward to the point where air is no longer passing through hot coke, the oxygen recorder reports the condition at once.

The average cost of a fatality for the past two years has been $26,000. Cases which the safety men call Permanent Totals, are costing between $75,000 and $100,000. In addition to the high cost of property damage the indirect costs of even minor accidents are even greater than the direct costs—time lost by supervision in investigations, in breaking the news to the family—cost of training a new employee to fill the job—the cost of lowered employee morale—poorer public relations.

Employee Suggestion Develops Steel Ferrules for Wire Loops



An employee suggestion submitted by Norman A. Olson and Arnold H. Mueller, transportation department, Public Service Co. of Colorado, Denver, brought time and money saving results, according to an announcement from the company.

Their suggestion was "that steel ferrules be used to hold a formed loop on the end of truck winch lines and wire rope slings."

The top photograph shows the old method with frayed end strands that can cause accidents, and thick clamps that will not pass through sleeves.

The bottom picture shows the new way. The splice will pass through sleeves and under loads with one inch clearance.

Mr. Olson and Mr. Mueller received an award of $100.

Gas Companies Plan to Spend $4½ Billion in 5 Years

Gas utility companies and pipe line companies in the United States expect to spend approximately $4.59 billion for construction of new facilities and expansion of present plant and facilities in the five year period from 1951 through 1955, according to a survey by the bureau of statistics of the American Gas Association. During the past five years, 1946-1950, the nation's distribution and pipe line companies spent $3.99 billion for the purchase and construction of new plant and equipment.

More than a year ago, the association predicted that for the first time in history, gas utility and pipe line companies in 1950 would spend more than one billion dollars for new construction. The industry actually expended $1.19 billion for new plant and equipment.

The forecast for 1951 indicates estimated expenditures of $1.54 billion and it is estimated that the industry will spend an additional $1.30 billion in 1952 to take care of prospective new customers and increased consumption of present customers. Estimates declined to $707.5 million for 1953, $553.8 million for 1954 and $492.8 million to be spent for construction in 1955.

As during the past five years when $2.19 billion were spent, natural gas transmission lines continue to represent the largest single category of expenditures with $2.40 billion or nearly one-half the total expenditures being devoted to natural gas construction. Because the rapid growth of natural gas distribution is bringing a major transition in the gas industry, the forecasts for the manufactured, mixed and liquefied petroleum gas branches were combined. Total expenditures of $397.2 million were forecast for these branches during the next five years. Anticipated expenditures for the development of underground storage facilities for the first time were shown in the current survey. The gas industry expects to spend $92 million for such facilities in the coming five-year period.

A construction program of this magnitude connotes a major financing program ahead for the gas industry. Tentative estimates show that about 30 per cent or $1.4 billion of the $4.59 billion needed will be available from various internal sources, leaving about $3.2 billion to be raised from outside financial sources. It is estimated that, of the latter amount, about $900 million will represent preferred and common stock issues and the rest or $2.3 billion will consist of debt issues.

The transmission line estimates included in this survey were based on projects for which certificates of approval have been granted by the Federal Power Commission as of June 1, 1951, plus allowances for some pending pipe line projects for which the prospects for approval were bright.

Code of Ethics for Manufacturers Of Industrial Gas Equipment

A statement of necessity for a Code of Ethics governing the conduct of manufacturers of industrial gas equipment, and the code as drawn up by members of the Industrial Gas Equipment Division of the Gas Appliance Manufacturers Association is reproduced herewith in its entirety. Editorial comment on the code will be found on page 9.

"Since industrial gas equipment is designed and constructed largely to the individual customer's order only, it is not possible for manufacturers to operate in accordance with a system of approving and publicizing American Standard of safety and durability as such standards do not exist for this type of product as in other gas appliance fields. In the absence thereof, it is believed that a need exists for a list of reputable manufacturers of industrial gas equipment who pledge themselves to a Code of Ethics to take the place of such standards.

"Conscious of their obligations to the public in matters of safety and reliability, each of the manufacturers whose name appears herein has pledged himself to the following Code of Ethics, recognizing that the significance of such Code and the reputation of this industry depends in part upon his own integrity and honesty in the representations which he shall make with respect to his product and the care which he shall exercise in its design and construction.

Code of Ethics

1. We shall make every attempt to design our products in accordance with sound engineering principles and the results of proven research and to construct our product with superior workmanship and materials.

2. We shall, to the best of our ability, assign to our product accurate and dependable input and output ratings.

3. We shall seek always to design and construct our product with a view to its satisfactory performance over its reasonable expected life.

4. We shall stand ready at all times to cooperate in the preparation and application of American Standards of the American Standards Association applicable to our product.

5. We shall apply to the selection of controls and accessories used in our completed product the same high standard of care and the same regard for American Standards of the American Standards Association, respecting both safety and durability exercised in its design and construction.

6. For the assistance and convenience of installers and users of our product, we shall, wherever practicable, furnish therewith carefully prepared directions for installation and use.

7. In presenting our qualifications, we shall make only such representations as are consistent with integrity and the highest standards of our industry, and shall scrupulously avoid any false, misleading or deceptive statement with respect to the grade, quality, design, construction or performance of our product.

Michigan-Wisconsin Applies For Rate Increase

Michigan-Wisconsin Pipe Line Co., Detroit, has applied to the Federal Power Commission for an increase of approximately $3,700,000 in its rates for wholesale natural gas service, based on anticipated sales for the 12 months ending March 31, 1952.

Michigan-Wisconsin's proposed increase would amount to 3.5 cents per thousand cu. ft., an increase of 12.5 per cent.

Amere Gas Utilities Announces Expansion Plans

Amere Gas Utilities Company, of Charleston, W. Va., has asked the Federal Power Commission for authority to construct approximately 33.6 miles of pipe line in West Virginia to increase the capacity of its system to supply the natural gas requirements of present customers.

The company plans to build about two miles of line in Wyoming County to reinforce the gas supply to Mullens, W. Va.; to construct approximately 16.5 miles of line in Mercer County to supply additional requirements of Princeton and Athens, W. Va., and to supply gas at wholesale to Bluefield Gas Co., and to build approximately 15.1 miles of line in Raleigh and Mercer Counties to transport gas from Atlantic Seaboard Corporation's Flat Top compressor station to Amere's distribution operations in Beckley, W. Va., during winter months.

Hess Lauds Steel Industry's Expansion But Sees More Line Pipe Needed

In order to meet the rapidly expanding demands for natural gas, the steel industry has more than tripled its capacity for making line pipe since 1946, according to a report issued June 21 by the Gas Appliance Manufacturers Association.

Since the middle of 1945, the Federal Power Commission has authorized the construction of 29,875 miles of natural gas pipe lines, requiring 6,768,300 tons of steel, Frederic O. Hess, GAMA president reported.

At the same time, Mr. Hess said, the steel industry has broadened its output of line pipe from less than a million tons in 1946 to a point where 3,668,511 tons were actually shipped last year. The 1946 production of line pipe, totaling 974,000 tons, represented less than two per cent of the steel industry's shipments of all steel products, whereas, in 1950, line pipe shipments were slightly more than five per cent of the industry's total, he added.

"However," Mr. Hess declared, "the demand for pipe lines, by both the gas and oil industries, obviously will continue at the present rate for some time to come. It is hoped, therefore, that the expansion program of the steel industry includes additional manufacturing facilities for line pipe. Only then does it seem possible to satisfy the needs of our fuel distribution system."

The importance of continued expansion of line pipe capacity is immediately apparent, he declared, from the fact that, on January 1, FPC had applications pending for another 15,866 miles of natural gas lines, requiring an additional 3,114,300 tons of steel.

During the first quarter of this year, the steel industry shipped 724,479 tons of line pipe, representing 3.7 per cent of its total shipments. However, Mr. Hess pointed out, in many areas the installation of line pipe is a seasonal project and first quarter shipment figures cannot be projected to give an estimate of the year's total. Supporting this, he noted that the volume of line pipe shipments had already begun to climb in March.

Of the 29,875 miles of gas pipe lines authorized by FPC up to January 1, some 17,621 miles, which required an estimated 3,757,100 tons of steel, are completed and operating. Another 12,254 miles of line, involving 2,011,200 tons of steel, had not been completed at the year's beginning, the GAMA president revealed. However, the steel industry's production of line pipe must satisfy the needs of both the natural gas and oil industries, he said. Taking both these uses into consideration, it seems unlikely that the supply of line pipe available this year will total more than half the industry's need, Mr. Hess added.

He noted that Deputy Petroleum Administrator for Defense Bruce K. Brown recently reported that: "it appears that the total supply of line pipe in the months immediately ahead is likely to equal less than two-thirds of the planned usage by oil and gas companies."

After deducting certain amounts of small diameter pipe for essential uses, it is highly improbable that the supply of large diameter pipe will meet more than 50 per cent of the amount needed, Mr. Brown added.

The completion of projected natural gas lines, which would bring the benefits of natural gas to additional thousands of consumers and industrial users, is of inestimable importance to the defense effort, Mr. Hess declared.

He pointed out that the probability of a supply pinch in both solid and liquid fuels in the event of all-out war makes the maximum distribution of natural gas vital to the security of the nation.

PREPARATIONS FOR NATURAL GAS CHANGE-OVER

AS MADE BY BROOKLYN UNION

The next four pages of American Gas Journal are —in an edited fashion—what The Brooklyn Union Gas Co. told its employees about conversion from manufactured gas to natural gas, by a special supplement in its employee magazine. Illustrations are by courtesy of "The Brooklyn Union Gas News."

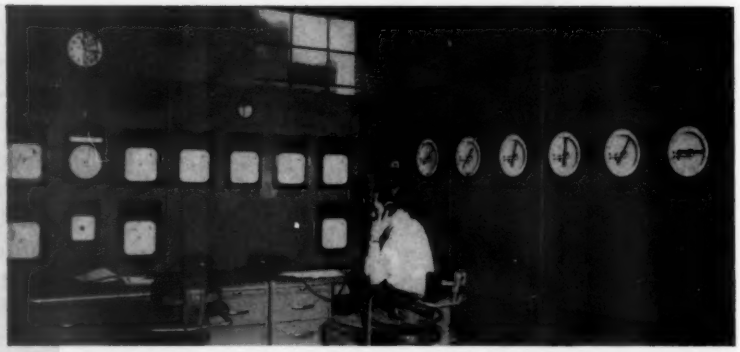
FINDING THE MAIN. Before a valve can be installed, the main must be found. Here a main is being located by Junior Engineer Albert G. Neuffer who is using an electronic detector known as the M-Scope.

A COMPLETED SECTIONALIZING VALVE. Only roadway boxes over purge pipes, right and left, and a box covering valve and test connection, center, are needed to complete this installation. These will be installed while backfilling.

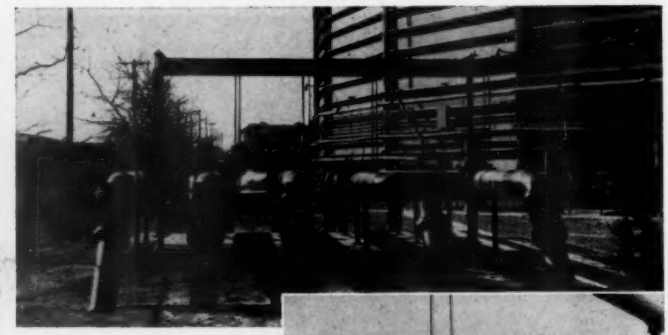
PREPARING FOR CHANGE-OVER FROM MANUFACTURED GAS TO NATURAL GAS, which is scheduled to start on March 6, 1952, the distribution system is being divided into fifty-eight districts of about 16,000 customers each. Approximately 1,200 sectionalizing valves are being installed in mains. These valves will permit the isolation of a particular district from adjacent districts when conversion is actually taking place. Here John Cohoon of development and planning department places a flag on large master conversion map located on fifth floor of general office building to indicate that another sectionalizing valve has been installed. The distribution department has already completed about 250 installations.

NEW EQUIPMENT AT GREENPOINT WORKS

A CLEAN FUEL for consumers is insured by these dust scrubbers at Greenpoint Works which remove fine particles of dust, sand and pipe scale from the natural gas as it is received.



PORTION OF NEW CONTROL HOUSE at Greenpoint Works where flow of natural gas is regulated. Here Controlman Edward J. Clarke directs flow.



NATURAL GAS BILLING METERS at Greenpoint Works measure amount of natural gas received via 1,840-mile pipe line of the Transcontinental Gas Pipe Line Corporation. Shown are four meters and test run.

ODORIZER AT GREENPOINT WORKS provides odor in natural gas. It adds Calodorant Special "C," to give fuel a distinctive odor.

CONVERSION ORDER RECORD GROUP sorts issues and controls all conversion orders for customers and appliances. Here Supervisor Louis Hroch, accounting department, checks map with Eleanor Bittner to determine exact boundary line of conversion district. A record of the number of meters in each district is being typed by Mary Speranza for forwarding to development and planning department.

CONVERSION ORDER RECORDS are being stamped with district numbers by Jim Clark as Edward McLaughlin, right, inserts street tabs into file guides separating records. Frank Tennant, assistant manager of meter reading section, commercial department, notes progress of work.

ESTIMATING SERVICE CALLS. [...]bert, left, customers service [...] Jack DeStefano and Bob Davis [...]ber of service calls expected [...] starting next March. Information [...] planning for telephone boards, [...] "can't get in" group.

SURVEYING CUSTOMERS. F. H. Bradler, of Conversions and Surveys, Inc., experts who have done this work all over the country, calls on a customer to survey her appliances. He records the name, model and serial number of her range, as part of a 1¼ per cent survey that will be used as a basis for ordering the proper material to convert domestic appliances when natural gas arrives. The conversion firm has surveyed 60,000 commercial and industrial accounts and spot-checked 10,000 domestic customers in getting ready for change-over.

SAFETY FIRST! Taking samples of flue gases to determine combustion characteristics. Chemist Bernard Mann, laboratory, is analyzing flue products gathered by flue gas collector shown atop old style gas range.

DETERMINING FLAME CHARACTERISTICS of an industrial burner that is burning natural gas. Results will be compared with data on present mixed gas. Appliance utilization engineer John Percy, new business, is running this test at the appliance testing laboratory at Citizens Works.

DRILLING BURNER PORTS on a Garland restaurant broiler. Junior Engineer Joseph Cahill, new business, shows what will take place during change-over when customers' appliances are converted.

CALLS. ctor Alfred K. Al- ervice ment, works with b Davis timating the num- pected d conversion period formatio ssed on to group boards, e equipment and

THIRTY NEW TELEPHONE TURRET BOARDS, on desks, were installed in the orders and records section, customers service department, in anticipation of expected tripling of service calls during change-over. Fifteen more, plus other telephone equipment, will be put in before March 1952, to increase telephone positions in orders and records to seventy-three.

(Brooklyn Union Gas Explains Conversion Preparations to Employees

Continued from preceding page)

OUR CUSTOMERS WILL BE KEPT INFORMED

A steady stream of information will be released by the Publicity and Advertising Department to keep our customers informed of developments during the conversion program.

There will be advertisements and stories in the newspapers explaining that change-over will necessitate conversion of customers' appliances. Each customer will also receive a broadside with a little booklet explaining the whole program and a map of our territory.

Seven days before a customer is actually converted, he will receive a notice in the mail giving him instructions as to what to do and telling him that in about a week natural gas will be supplied in place of our present gas. On the actual day of conversion he will be well aware of what is to take place for, on the day previous, a doorknob sticker will be attached to his front door repeating previous instructions. As we plan also to employ radio and television announcements, without doubt every customer will know that natural gas is coming into his premises and that conversion experts are coming around to adjust his appliances.

THE CHANGE-OVER CUSTOMER RELATIONS GROUP which is in charge of preparation of advertising, publicity, customer notifications, manufacturers' contacts, talks to civic groups, notifications to builders, dealers and distributors, and other forms of public information under the natural gas committee.

•

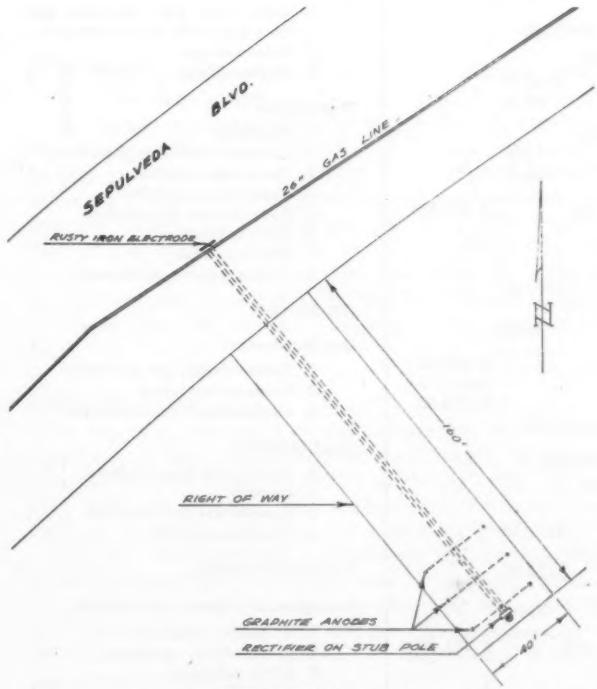
An essential to a smooth and unmarred conversion operation is thorough employee briefing on every step in the process well in advance of actual changeover. In the interests of public relations it is necessary not only that the non-technical as well as the operating personnel know exactly what is being done. They must also know how and when and why. This pattern of simple preliminary education as addressed to its employees by The Brooklyn Union Gas Company may readily be adapted to the requirements of other gas companies facing the job of conversion within the next few months. EDITOR

•

THE CO-ORDINATOR'S GROUP. The function of this group is to direct the physical work to be done during conversion.

Installation and Comparative Costs Given For Steel vs Graphite Anodes

by J. S. Dorsey
Southern California Gas Co.



Left: Fig. 1—Graphite anode installation on Sepulveda boulevard.

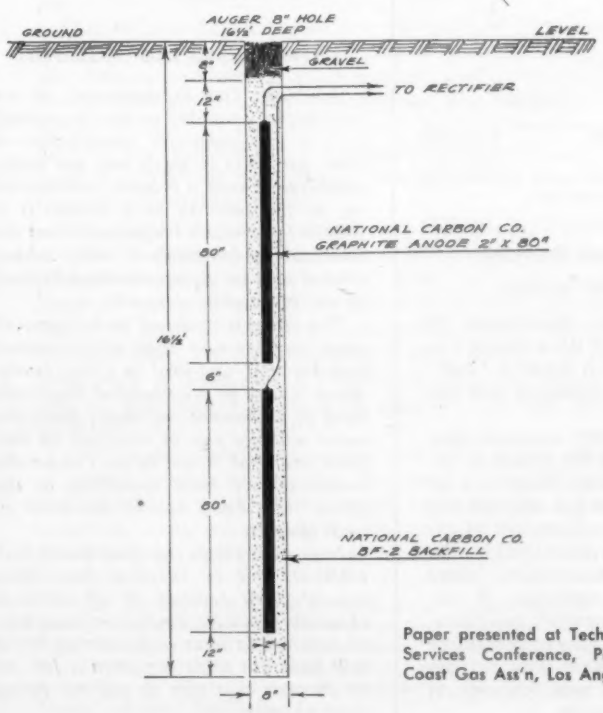
Left, below: Fig. 2—Method of installing graphite anodes.

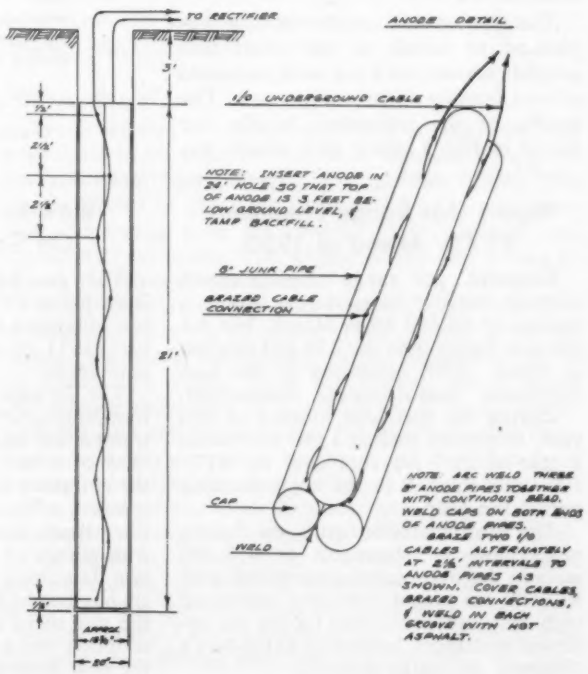
Right, below: Fig. 3—Method of installing verticle steel anode.

PRESENTED briefly are some notes on the installation of graphite anodes at one particular location, and the cost comparison between graphite anodes and vertical steel anodes.

The only right-of-way which could be secured at this location was a lot 40 feet wide by 160 feet deep. It was desired to install the anode as far away from the pipe line as possible; and it was also desired to use a rectifier with a direct current output of 25 amperes at not over 24 volts, which in turn required an anode resistance of not over 0.96 ohm. A group of vertical anodes located near the rear of the lot appeared to satisfy these two requirements better than other types of anodes. The choice then had to be made between graphite or steel anodes, and this was done on the basis of a cost analysis of the two which showed graphite anodes to be approximately $320.00 cheaper at this particular installation.

Fig. 1 shows the location of the pipe




TO RECTIFIER
ANODE DETAIL
3'
1/0 UNDERGROUND CABLE
½'
2½'
2½'
NOTE: INSERT ANODE IN 24" HOLE SO THAT TOP OF ANODE IS 3 FEET BELOW GROUND LEVEL, & TAMP BACKFILL.
8" JUNK PIPE
BRAIDED CABLE CONNECTION
21'
CAP
WELD
NOTE: ARC WELD THESE 8" ANODE PIPES TOGETHER WITH CONTINOUS BEAD. WELD CAPS ON BOTH ENDS OF ANODE PIPES. BRAID TWO 1/0 CABLES ALTERNATELY AT 2½' INTERVALS TO ANODE PIPES AS SHOWN. COVER CABLES, BRAIDED CONNECTIONS, & WELD IN EACH GROOVE WITH HOT ASPHALT.

Paper presented at Technical Services Conference, Pacific Coast Gas Ass'n, Los Angeles

line, right-of-way, and nine vertical anodes. These anodes were spaced 15 feet apart in the form of a square. The rectifier was installed at the rear of the lot as it was desired to screen it from the street as much as possible.

Graphite Anodes

It was calculated that if nine graphite anodes were installed, they should be 16½ feet deep and eight inches in diameter in order to secure the desired anode resistance. This is considerably deeper than recommended by the manufacturer of these anodes, for the average or normal installation, and since it was necessary that the anode be effective to the bottom of the hole, it was decided to install two graphite rods in each hole as shown in Fig. 2.

Tests that were made after the installation had been completed showed that this was not necessary, at least at this time. The total anode resistance was the same whether only one rod or both were connected. If future tests disclose that this condition will remain unchanged, it is planned to use only one graphite rod located at about the center of the anode hole in additional installations of this type.

National Carbon Co. BF-2 backfill was used in this installation. However, laboratory tests indicate that selected coal coke should be suitable for backfill material as far as its resistivity is concerned in most types of soils, and this is considerably cheaper. The anode holes were drilled with conventional earth-drilling equipment which is quick and not expensive as long as the ground does not cave in and no rock is encountered.

Steel Anode

The type of steel anode which it was planned to install, in the event that graphite anodes were not used, consisted of nine bundles of three pipes each. The details of an individual bundle are shown in Fig. 3. Since each bundle has a larger diameter than a single graphite anode, the interference effect between the individual bundles would be greater than between individual graphite anodes, and therefore it would be necessary to install the steel bundles at a greater depth in order to secure a similar total anode resistance. The size of steel pipe was selected so that this anode should last for 25 years, since this is the life expectancy of the graphite anodes.

Cost of Graphite vs Steel Anodes

A cost comparison between these two types of anodes is shown below:

1. GRAPHITE ANODES

	Material	
18	Graphite rods	$142.76
	Plus freight	25.46
2900 Lb.	National Carbon Co. BF-2 backfill	119.07
	Plus freight	136.71
	Total material cost.....	$ 424.00
	Labor	
	Augering 9 anode holes	$225.00
	Installing anodes and backfill	50.00
	Total labor cost.....	$ 275.00
	Grand total—..... (labor and material cost)	$ 699.00

2. STEEL ANODES

	Material	
6¼ Tons	Junk steel pipe at $50.00 per ton	$312.50
432 Ft.	1/0 underground cable	130.00
	Miscellaneous, asphalt, etc.	25.00
	Total material cost.....	$ 467.50
	Labor	
	Augering 9 anode holes	$324.00
	Welding and preparing anodes and installing in holes	225.00
	Total labor cost.....	$ 549.00
	Grand total—..... (labor and material cost)	$1016.50

Report Gas Range Shipments 21.7% Ahead of 1950

Domestic gas range manufacturers shipped 249,600 units during April, a decline of 54,400 from March, but 4.4 per cent higher than the 239,100 shipped in April, 1950, according to the Gas Appliance Manufacturers Association.

During the first four months of this year, shipments totaled 1,067,200 units, a gain of 21.7 per cent over the 877,100 units shipped in the corresponding period last year.

The latest available figures on electric ranges indicate shipments of 478,500 units in the first quarter, compared with 817,600 gas ranges, reflecting continued high consumer preference for the gas operated appliances, according to GAMA's domestic gas range division.

Blaw-Knox Issues Booklet On Gas Conditioning

The gas equipment department of Blaw-Knox Division of Blaw-Knox Co. has published a research bulletin (number 2353) on gas conditioning and gas equipment.

The 20-page pamphlet contains photomicrographs showing the effects of entrained wet and dry dusts. There is a review of a new method for determining the entrained dust and oil content of gas streams, a "yardstick" developed by the Blaw-Knox research department, along with photos of testing apparatus. A section describing the company's gas cleaners has graphs showing how to determine the size to be used. There is also a description and a table of specifications on the new Blaw-Knox fogger.

American Gas Fundamentals

OUTLINE

Natural Gas
1. Geology
2. Drilling and Production

Manufactured Gases
1. Coke oven gas; producer gas, blue gas; carbureted water gas
2. Reformed gas
3. Hi-Btu oil gas

Transmission
1. Pipe lines
2. Corrosion and pipe protection
3. Compressor stations
4. Super compressibility
5. Hydrates and dehydration
6. Gas conditioning
7. Flow formulae
8. Orifice meter measurement

Gas Storage

Gas Distribution
1. System design and operation
2. Pressure regulation
3. Measurement and accounting

Gas Utilization
1. Combustion characteristics
2. Domestic
3. Commercial and industrial
4. Interchangeability

Conversion Practices

Management Problems and Policies
1. Corporate structure
2. Public utility regulation
3. Public relations

How to Use the Material

American Gas Fundamentals *is not intended as a training or service manual. It is a comprehensive compilation of basic gas facts to guide any gas utility employee toward a broader understanding of the industry as a whole. It is written in layman's language so that the technical fundamentals of every subject treated may be digested and understood by the non-technical reader.*

The series is designed to be removed from each current issue of AMERICAN GAS JOURNAL *and filed in a ring binder where it may be accumulated into a text book of permanent usefulness. Since the series will not run in sequence as outlined, material should be filed under the major subject head appearing in the upper right hand box at the head of each chapter.*

New subscribers to AMERICAN GAS JOURNAL *will be supplied free, upon request, with reprints of all previous chapters. Younger employees who may be required to serve in the armed forces will have put aside for them a full set of all texts that may be printed during their absence.*

Transmission of Natural Gas

THE expansion of the natural gas industry which has been going on in this country for over 20 years was interrupted by World War II, but since then it has proceeded at an accelerated rate. As a result of this growth, natural gas from the southwest is being delivered to practically every section of the United States and the mileage of natural gas pipe lines now exceeds that of our railroad systems. Notwithstanding this, the capacity of our natural gas pipe lines falls far short of the market demands for this fuel and there is every reason to believe that the period of expansion will continue for years.

Early Pipe Lines

In the very early days of the natural gas industry the transmission lines, which were of short length, were constructed of pipe made of white pine logs. One end of each pipe section was bell shaped and the other end trimmed to fit the bell. Hot tar sealed the joints.

The first high pressure transmission system was built in 1891 to carry gas from wells near Greentown, Indiana, to Chicago. Wrought iron pipe, screw type, was used for this 120 mile line which was designed for pressures up to 525 pounds. It is worth noting that 500 pounds pressure was about the maximum used up to 1930.

Practically all transmission lines laid prior to 1900 were wrought iron. Shortly after the turn of the century steel pipe became available at much less cost and it rapidly replaced wrought iron for transmission line work. As a matter of fact, the improvements which have since been made in the manufacture of steel pipe have played an important part in the development of our modern long distance transportation systems.

The construction of a modern long distance pipe line is a major engineering undertaking which requires the use of much heavy equipment. A very good idea of the work involved can be obtained from movie films that have been made on some of the recent construction jobs. Several excellent films are now available.† As a measure of the magnitude of these jobs, it might be pointed out that the cost of installing a fairly large system runs well over $100,000,000.

The first problem in connection with construction work, of course, is that of the pipe line route. A preliminary field survey is made by engineers to select the logical points for road, stream and railroad crossings and also to locate swamps and evidences of land slips. In this work, topographical and township maps are used, to locate a satisfactory route, and to obtain the names of land owners whose farms and properties are to be crossed by the line. Special aerial surveys also are often made.

Rights of Way

After the preliminary survey is completed, permanent rights of way are obtained from the owners of land to be crossed by the line.

Rights of way are easements granted by the land owner giving the pipe line company permission to lay, repair and finally remove pipe lines, together with the right of ingress and egress in operating and maintaining the line. Rights of way specify the amounts to be paid per rod of line actually laid and carry an agreement on the part of the company to pay the land owner for damages to crops and fences which result from the laying, repairing or removal of pipe.

Surveying

The proposed right of way is then surveyed. Oftentimes the route which is indicated on a map will be changed because of heavy rock formations, swamps or evidences of recent land slides. As far as possible, river and road and railroad crossings are kept to the minimum. The route of the pipe line is marked by driving stakes into the ground and the land is cleared of timber and underbrush.

Construction Work

Pipe is shipped in steel gondola cars to points as close as possible to the right of way. It is unloaded by a portable revolving crane powered by a gasoline engine. The pipe is hauled to the right of way by truck, tractor or team, depending upon the contour of the country and condition of the roads. The lengths of pipe are strung or laid on the ground, end to end.

The trench or ditch that is to receive the pipe is dug by machine wherever the condition of the country is not too rugged. The modern ditching machine includes a revolving wheel with digging teeth and buckets which loosen and remove the earth. It is driven by a tractor motor equipped with caterpillar treads. The dirt is dumped from the buckets into an endless conveyor and deposited upon the bank alongside the ditch.

The width of the ditch depends upon the size of the pipe and is usually deep enough to allow a 24 inch covering of earth as a minimum. Very large high pressure lines sometimes are covered with three or four feet of earth. The line should always be below plow depth.

Where heavy rock formations are encountered, it is necessary to drill and blast the rock. Portable air com-

† Pipe line construction films available for group showing may be obtained free of charge from the American Gas Association, 420 Lexington Ave., New York 17, N. Y. Titles include: "Gas," by the Tennessee Gas & Transmission Co.; "Westward Flow," Southern California Gas Co.; "Pipe of Plenty," Michigan Consolidated Gas Co.; "Eternal Flame," Columbia Engineering Corp.

pressors are used to supply air at high pressure through a rubber hose to the drill. After a hole has been drilled, dynamite is lowered into it and covered with dirt. An electric spark from a hand-operated magneto explodes the dynamite.

Laying the Line

Skids made of heavy lumber are laid across the ditch and the lengths of pipe are picked up by a pipe-carrying crane and placed on the skids. The pipe is then connected by welding or with couplings for a distance that depends on the size of the pipe and the contour of the country. The connected pipe is lifted high enough to permit removal of the skids and carefully lowered into the ditch.

Reasons for Burying Pipe

There are three main reasons for burying the pipe:

1. To allow for the tilling of farms crossed by the pipe line.
2. To provide sufficient weight or ballast to keep the pipe from parting due to the pressure exerted inside the line.
3. To keep the gas at a more even temperature, thereby decreasing expansion and contraction and lessening the tendency for the pipe joints to loosen or leak.

Pipe Protection

In order to protect the pipe from the effects of soil corrosion and electrolysis, it is customary to cover it with a coal tar or asphalt coating. This protective coating is applied to the pipe before it is lowered into the ditch and great care must be exercised to make sure that it is not damaged when the pipe is laid or when the ditch is filled with earth. To make sure that the protective coating will not be cut or dented by rocks and other material during the back filling of the ditch, the coated pipe may be wrapped with heavy paper, glass wool or other material.

River Crossings

River crossings are avoided whenever possible because of the time and expense involved in their construction. If the river is navigable, a permit to cross is required from the Secretary of War.

Small streams may be crossed with a single line, but it is customary to use multiple lines in the crossings of rivers of any size. Most frequently these multiple lines are buried in the bed of the river and gate valves are installed on each line on both sides of the stream. Thus, if one line is washed out, the other lines are capable of carrying the full gas load, while repairs are being made. Occasionally it is found advisable to make an overhead crossing with the pipe line supported by tall steel towers.

Railroad and Road Crossings

Extreme care is necessary in laying pipe under railroad crossings to eliminate, in so far as possible, the dangers of leakage. To this end joints of casings several inches larger than the pipe itself are welded together and run underneath the crossing. The pipe line itself is then welded and passed through the casing. Gate valves are installed on both sides of the railroad right of way which can be closed as needed for making repairs. The casing is provided with a vent which will dispose of gas should leakage occur.

Road crossings are made in much the same manner as railroad crossings except for the fact that gate valves may not be necessary.

Back Filling

The back filling of the ditch or covering of the pipe is done by machinery. Machines used for this purpose include caterpillar tractors equipped with swing boom and bucket which can be operated by one man, and bulldozers. After the ditch is filled, the right of way land is cleared up, fences repaired and the property crossed is put in good condition.

Testing the Line

Before operations are started, the line must be tested. Thermometers are inserted into the pipe section under test at not less than two points to allow for correction in pressure due to temperature changes. Recording pressure gauges are also installed to check pressure conditions. High pressure air is then introduced by means of portable air compressors and each section of the line under test is isolated and watched for at least 24 hours with respect to pressure. If any pressure drop is detected, the leak is located and repaired and the test operation repeated until the pressure holds steady for at least twenty-four hours. Gas is then introduced into the line and when it has forced the test air out, the line is ready for service.

Important Pipe Line Design Factors

There are five fundamental factors to be considered in the design of any new pipe line.

1—*Initial Pressure:* Generally initial pressures are dependent on pressures of the gas in a given field or upon pressures artificially produced by compression.

2—*Terminal Pressure:* This is the pressure required at the end of the line or at the gate of the city which receives service from the line.

3—*Maximum Rate of Flow:* This is the maximum quantity of gas which it is estimated will be required per day to meet the total demands of the market being served. Even though the peak demand may be required only once or twice a year, and then for a very short time, the line must be designed for this peak condition.

4—*Length of Line:* This obviously is the length between the two terminal points.

5—*Pipe Diameter:* This is the diameter required to deliver the required quantity of gas a given distance under given initial and terminal pressures.

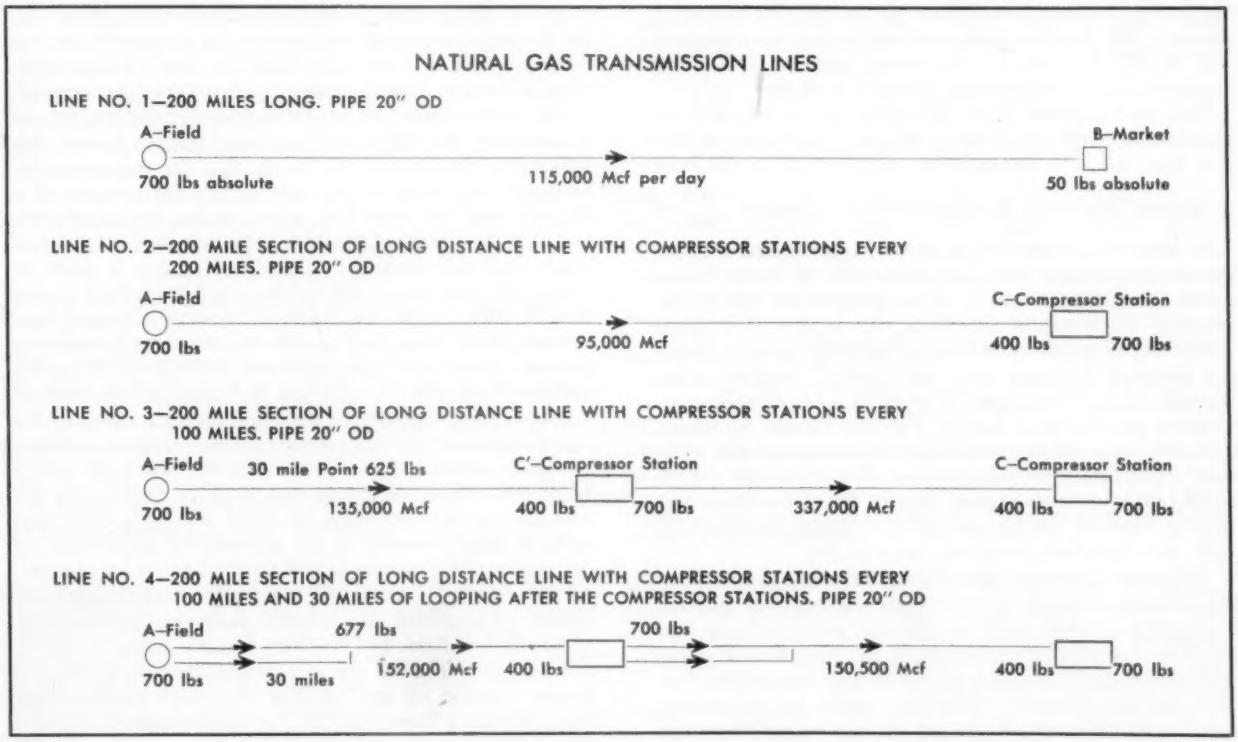
Weymouth's Formula

For many years scientists and engineers have been working to develop mathematical equations or formulae which can be used in calculating pressures, volumes, pipe diameters, etc., in connection with the flow of gas through pipe lines. The Weymouth pipe line flow formula has been generally accepted as the most accurate. In simplified form it is as follows:

$$Q = 670.8\, d^{8/3} \sqrt{\frac{P_1^2 - P_2^2}{GL}}$$

where

Q = cubic feet per 24 hours measured at 14.7 lbs. per sq. in. absolute and 60° F.
Flowing temperature of gas = 60° F.
P_1 = Pressure at starting point — pounds per sq. in. absolute.
P_2 = Pressure at terminal — pounds per sq. in. absolute.



d = Internal diameter of pipe, inches
G = Specific gravity of gas
L = Length of line, miles.

Simple Form Pipe Line Design

To understand the fundamentals of gas transmission, let us design together a very simple transmission line 200 miles long connecting point A in the gas field with city B the terminal market as shown in Line No. 1 on the chart. Let us assume that 700 pounds absolute pressure is available at A and 50 pounds is required at B, the city gate, and that careful study of the gas market requirements indicates that this line should have a capacity of 115,000,000 cu. ft. per day. It will be noted that four of the basic factors in this case are more or less fixed. By applying these known values to the Weymouth Formula we can readily calculate the requisite inside diameter of our pipe line system. Thus the diameter is found to be approximately 20 inches.

Barlow's Formula

It is also necessary to determine the proper wall thickness of the steel pipe for it must be strong enough to stand the proposed operating pressures, yet no thicker than necessary for safety, because the cost of pipe varies directly with its weight. For this particular problem, use is made of Barlow's formula for fiber stresses, which is:

$$T = \frac{d \times p}{2 \times f}$$

where

T = thickness of wall, inches
d = outside diameter of pipe, inches
p = internal fluid pressure in pounds per square inch
f = working fiber stress in pounds per square inch.

If the tensile strength of the steel used in making the pipe is 60,000 pounds, and we use a safety factor of three, the working fiber stress is 20,000 pounds. Under these conditions the proper wall thickness, according to the above formula, is found to be 0.35 inches.

Long Complicated Pipe Line System

Now let us proceed to the design of a longer and more complicated transmission system—line No. 2. Assume conditions are as follows: Length of line 1000 miles. Daily capacity 90,000,000 cu. ft. Maximum initial pressure 700 psia. Terminal pressure 50 psia.

In a long line of this type it is necessary to build compressor stations at several points along the line to restore the operating pressure. This is true because the flow of gas through a pipe line is caused by a difference in pressure while the volume of flow that is caused by a given pressure differential is dependent upon the length of the line. To illustrate: The capacity of a 20 inch line, 1000 miles long, with 700 pounds intake pressure and 400 lbs. terminal pressure is 42,500,000 cu. ft. per day, whereas the same capacity could be provided in a 200 mile line of the same diameter with 700 lbs. intake and 650 lbs. terminal pressure. If we lower the terminal pressure of the shorter section to 400 lbs., its capacity is increased to 95,000,000 cu. ft. per day. Hence, by installing booster or compressor stations every 200 miles to boost the pressure from 400 lbs. to 700 lbs., it is possible to bring the capacity of the 1000 mile system up to the capacity of the 200 mile system. To provide any such capacity in a long line without making use of compressor stations would require either a pipe line of very large diameter or extremely high pressures at the point of gas intake, and the cost of gas transmission would thus be increased greatly. With compressor stations every 200 miles we would require four stations on a 1000 mile line. At the first three

stations the intake pressure will be 400 lbs. and the outlet pressure 700 lbs., but at the last station the inlet pressure will be 400 lbs. wih a lower outlet pressure (580 lbs.) for, in this case, the terminal pressure is 50 lbs.

The next problem is to determine the horsepower requirements of the compressor stations. The important factors here are (1) compression ratio, which is the ratio of station discharge pressure to inlet pressure $\frac{700}{400}$ or 1.75 and (2) volume of gas to be pumped. For the proposed compression ratio approximately 40 brake horsepower per 1,000,000 cu. ft. of gas pumped per day will be required. Each station, therefore, will require 95×40 or 3,800 bhp of capacity. As these pumping stations, which are designed for peak load, will actually operate under variable loads, it is advisable to have a number of compression units at each station. For this reason, we would probably recommended 4—1000 bhp compressors per station or possibly 5, in order to provide a spare unit at each station. Compressor station No. 4 could be somewhat smaller since it would operate at a lower compression ratio and, therefore, have less work to do.

The compressors are generally single stage gas compressing cylinders directly driven by gas engines. The fuel for the engines is taken from the pipe line with the result that the final deliverability capacity of the pipe line is somewhat less than the capacity of the first section of the line. The line, as designed, therefore, would be capable of handling 95,000 mcf of gas per day up to the first compressor station, while its deliverability capacity at the terminal would be approximately 92,000 mcf.

In designing a new long distance pipe line it is always advisable to make some provision for increasing its capacity readily and economically. This is true because a line necessarily must be designed for the estimated gas requirements of a given market, and experience proves that these estimates are almost sure to be far below the ultimate actual demands for gas. In the case of our 1000 mile line, a worth while increase in capacity can be provided by installing new compressor stations midway between existing stations, that is, by having a station every 100 miles—Line No. 3. With these additional stations in operation, capacity of the line can be increased to 135,000,000 cu. ft. per day. If still greater capacity should be called for, we would have to parallel the system in part by installing a second line for a given distance after each compressor station. It might be noted that while it is desirable to have compressor stations located at regular intervals along the line, it is essential to have good cooling water at each station. For this reason it is generally not possible to have exactly the same distance separate the various stations.

Looping

Many laymen are mystified by the capacity increase which is obtained by installing relatively short sections of duplicate lines at regular intervals throughout the system. It is difficult for them to understand how the capacity can be increased when all the gas has to be carried by the original single line for long distances. The mystery, however, is readily cleared up by a study of the fundamentals of gas transmission. As stated previously, the flow of gas is caused by the differential pressure, and the greater this differential the greater will be the flow for any given distance. In our study we have developed the capacity of a 20 inch line 100 miles long with 700 lbs. intake pressure and 400 lbs. terminal pressure. The pressure on this line drops gradually from 700 to 400 lbs. and at a point 30 miles from the compressor station is 625 lbs., which means that the flow of gas for the next 70 miles is caused by a pressure drop from 625 to 400 lbs. Now let us install a parallel 20 inch line for a distance of 30 miles from the station—Line No. 4. The gas will now travel through two lines for a distance of 30 miles and as a result of the lower resistance to flow, there will be a higher pressure available at the 30 mile point than was the case with a single line. Thus the differential pressure forcing the gas through the next 70 miles of travel will be greater and cause a larger volume of gas to flow. By application of the Weymouth Formula it will be found that by paralleling the original line for 30 miles after each compressor station, as suggested, it is possible to increase the capacity of this system from 135,000 mcf per day to over 152,000 mcf per day. The 70 miles of single line will carry this greater volume of gas because its intake pressure has been increased from 625 lbs. to approximately 677 lbs. Although the looping may be installed on the inlet side of the compressor stations, the principle seems more readily understandable by looping on the discharge side.

There are, of course, numerous other problems connected with the designing of a gas transmission system, such as type of joints to be used in connecting the pipe, location and type of gate valve, etc. Most modern pipe line systems are welded because the welded joint offers maximum strength and other important advantages.

In actual practice the design of a long distance transmission system presents not only many interesting engineering problems but several complicated economic problems as well. For example, a system of similar capacity to the one used herein to illustrate the fundamentals of the problem could be designed with either smaller or larger diameter pipe. With smaller pipe it would be necessary to install greater compressor station capacity whereas with larger diameter pipe, less compressor station capacity would be adequate. It is necessary, therefore, in all cases to study the various possible design combinations from the standpoints of investment, of operating costs and expansion possibilities.

NOTE: The Weymouth formula, in its original form, as given in most text books has been used in this study because of its relative simplicity. In actual practice consideration, of course, is given to the deviation from Boyle's Law that occurs when pressures are high, say 200 lbs. or more. The Weymouth formula with this deviation factor incorporated, will be found in the 1951 edition of "American Gas Handbook."

This chapter on transmission was prepared by Charles R. Bellamy, consultant.

Index of Yields : Selected Utilities Stocks

	June 1951	May 1951	Apr. 1951	Mar. 1951	Feb. 1951	Jan. 1951	Dec. 1950	Nov. 1950	Oct. 1950	Sept. 1950	Aug. 1950	July 1950
Natural Gas Transmission Companies	5.26%	5.35%	5.22%	5.38%	5.31%	5.36%	5.97%	5.62%	5.19%	5.71%	5.46%	5.76%
Natural Gas Transmission & Distribution Companies	5.30	5.45	5.43	5.35	5.31	5.47	5.67	5.46	5.40	5.61	5.71	5.79
Manufactured & Mixed Gas Companies	5.22	5.35	5.23	5.22	5.21	5.22	5.56	5.46	5.24	5.52	5.55	5.76
Class "A" Electric Companies	5.95	5.88	5.52	5.49	5.65	5.62	6.19	6.03	5.56	5.67	5.59	5.64
Class "B" Electric Companies	5.88	5.94	5.72	5.66	5.78	5.80	6.38	6.06	5.99	6.06	6.35	6.41

Method of Compiling Index of Yields

This is a straight arithmetical index of comparative yields obtainable on a selected group of gas and electric utility industry common stocks.

The companies comprising this index have been selected by the AMERICAN GAS JOURNAL as providing a representative cross-section of each industry, from the standpoint of geographical diversification and of the relative importance of the individual companies in their areas.

No effort has been made to weight the average to give effect to changes in capitalization or in dividend rates because the yields afforded on the issues reflect such changes. The index is designed to show the rate of return and not necessarily market movements on the stocks comprising it.

The companies used in compiling this index are:

Natural Gas Transmission Companies: El Paso Natural Gas Co.; Northern Natural Gas Co.; Panhandle Eastern Pipe Line Co.; Southern Natural Gas Co.; Tennessee Gas Transmission Co.

Natural Gas Transmission and Distribution Companies: Columbia Gas System, Inc.; Consolidated Natural Gas Co.; Lone Star Gas Co.; Oklahoma Natural Gas Co.; Pacific Lighting Corp.

Manufactured and Mixed Gas Companies: Bridgeport Gas Light Co.; Brooklyn Union Gas Co.; United Gas Improvement Co.; Peoples Gas Light & Coke Co.

Class "A" Electric Companies: Boston Edison Co.; Commonwealth Edison Co.; Houston Lighting & Power Co.; Southern California Edison Co., Ltd.

Class "B" Electric Companies: Dayton Power & Light Co.; Hartford Electric Light Co.; Pennsylvania Power & Light Co.; Public Service Co. of Colorado; San Diego Gas & Electric Co.

John F. Falvey

As will be seen from the AMERICAN GAS JOURNAL index of yields, the utility companies recently have had a good stock market in which to bring out new common shares; and the record shows that they have been awake to the oportunity.

During the initial half of 1951 the electric and gas utilities brought to market approximately $300 million of common stocks. These offerings, together with others which have not yet actually come to market but which are definitely headed that way during the next several weeks, exceed the rate of common stock sales which the utilities had estimated would be required to finance the construction programs which they faced.

Average yields on gas industry shares as a whole now are less than those obtainable on the electric utility stocks as a group. The diminishing return in dividend income, plus an increase in interest rates on new corporate bonds, has narrowed the spread between bond and stock yields to the smallest margin which has existed for many months.

The gas stocks as a group now afford a return of about 5½ per cent. This compares with nearly three per cent provided on highest grade corporate bonds; 3.05 per cent on second grades; nearly 3.30 per cent on soundly rated issues; and about 3.45 per cent on bonds just falling short of that calibre.

The margin may be pared even further if the hesitancy shown by government and corporate bonds alike at the time of this writing should extend into another sharp sinking spell for debt securities.

But the narrowing should not be such as to seriously interfere with the recent favorable flow of investment funds into utility shares, according to seasoned and qualified market observers.

Scarcity of institutional money and the sagging bond market have combined to spell hard sledding for the investment underwriting firms in getting the recently issued corporate bonds into investors' hands. A prime case in point are the Peoples Gas Light & Coke Co. bonds. Only a little more than half of this "A" rated issue had moved from dealers' shelves within the first three days after their offering.

A life saver for the underwriters, however, may be the dearth of new corporate bonds headed for market in the first half of July, at least. This may create a void which will enable the bankers to clean up the balance of the issue without too much difficulty, unless the bond market as a whole should "fall out of bed."

The difficulty attending the Peoples Gas placement is due not to any weakness in the company's situation but solely to the decline of about 20 basis points in the bond market as a whole during the past two months.

Still higher interest costs for corporate borrowings during the next several years was forecast recently by the head of one of the nation's banking firms, George D. Woods, of First Boston Corp. He accompanied his prediction in this respect with a warning that the utilities would have to seek higher rates from consumers and increase their payout of dividends to 80 per cent of earnings available for the purpose if they wished to raise satisfactorily the one billion dollars of common stock money as part of the $7 billion over-all financing job they will have to do by the end of 1953.

The writer cannot see anything but higher rates for most companies in the period directly ahead if they are to obtain the funds absolutely needed to carry out their programs.

But the utilities may not have to "raise" their proportion of dividends to earnings. Uncle Sam may do this for them automatically by increase in corporate tax rates now in the offing.

The tax bite may take quite a deep bite from corporate profits, but the leeway now existing between earnings and dividends may permit maintenance of present rates to stockholders and thus lend support to further efforts of utility firms and others to finance a substantial part of plant and equipment expansion through sale of equity shares.

Management is well aware of the need to keep up dividend payments and it is significant that in the first half of 1951 dividend reductions or omissions were less than half of those witnessed during the corresponding period a year ago.

Capital expenditures to date in 1951 have exceeded the level of 1950's similar period and it is estimated by responsible authorities that the total of such spending for all of 1951 will run about 30 per cent above 1950.

In their search for new capital with which to purchase badly needed plant and equipment the utilities and other corporations cannot look to institutional investors with the same high hopes they

(Continued on page 43)

Natural Gas Can be Cleaned of Dust At Regulating Stations

by Calvin A. Brown
Rochester Gas & Electric Corp.

DUST in the gas distribution system is not a new problem. Wherever conversion from manufactured to natural gas has taken place dust problems have arisen. Rochester Gas and Electric Corporation was no exception in this matter. We decided to convert a section of about 9000 customers to natural gas and started the conversion in June 1950. Even though we started fogging this section after the conversion with a standard cold fogging oil at the rate of about two gallons per million cubic feet, within three months, pilot outages, due to dust, became such a problem that every means of solving it was investigated.

The first area converted consisted of some 1756 customers in a low pressure district fed by a district regulator. The second area converted consisted of 1480 customers in a medium pressure district operating at about ten pounds. All went well until three months later when a flood of complaints of pilot outages were received from the low pressure district. As many as 134 complaints per day were received from this district.

Tests were made to determine the efficiency of oil fogging in the natural gas system. The tests in the low pressure area showed a considerable quantity of oil vapor in the gas stream at the farthest points. Tests in the medium pressure system showed that small amounts of oil vapor reached about three miles. There was some evidence that oil fog had penetrated beyond this point but a testing device, using glass slides, indicated that the deposits were chiefly dry iron oxide dust to the end of the line.

The low pressure regulator was examined and found filled with a very fine dust consisting chiefly of iron rust and manufactured gas deposits.

Our problem then was two-fold: first, interference with the district regulator operation as dust in the chambers under the valve caused a build-up. Also, there was the danger of erosion of the valves and valve bowls. Second, pilot troubles due to dust. How then could we eliminate the dust from our district regulators and also from our distribution system?

First of all, we made tests to determine the type of dust with which we were dealing. Samples removed from the regulator indicated that the deposit was largely iron oxide and manufactured gas deposits, as evidenced by the large percentage of total sulphur. The dust was also extremely fine, some of the particles being in the nature of one to two microns in diameter. Similar tests were made of the deposits found in pilot filters and on the regulator seats of the house regulators in the medium pressure district. The analysis of these deposits were very similar to those found in the district regulator. With regard to filter and pilot needle point stoppages, there appeared to be three general types; (1) A black sticky, oily, gummy type of deposit which was found generally in the converted natural gas areas on needle points, regulator seats, etc. An analysis of this deposit showed that it was chiefly of iron oxide, oils and tars, and liquid and vapor phase gums which were probably derived from the manufactured gases. These deposits may have been already present at the critical locations in certain quantities and our theory is that the drying out of the mixture of these with the dry oxide dust caused them to thicken and become sticky to the objectionable stage. (2) The other two types of deposits appeared to be fairly well confined to the low pressure area under specific consideration. One was a dark-colored oily deposit found in pilot tubes which appeared by comparative test to be composed of oil fog and gas main dust. The greenish-blue color left by the fog oil was observed in some of these deposits. (3) The third type of deposit found particularly in the low pressure system in question was a relatively dry oxide dust soluble in acid. This was found on the test slides in varying quantities which seemed to change with the weather i.e., the gas load. This deposit was also found particularly in pilot filters stopping them up completely.

It seemed evident from the results of the test that oil fogging in this district was excessive at some period but that oil fog alone did not result in any great number of stoppages. The oil may have trapped oxide dust, however, and aggravated the stoppage at many locations. The chief cause of the stoppages in the low pressure area appeared to be due to a manufactured gas main dust. It was also possible that a part of this dust was coming in with the natural gas. Up to this point, it appeared that the stoppages apparently were due to excessive fog oil and dust, and were almost entirely confined to the low pressure area under consideration and that stoppages apparently due to sticky tars, gums, and dust were generally scattered throughout the natural gas converted area and in considerable lesser concentration.

Fogging was discontinued at this point. Test tubes were installed at the high points in the main and a "wetting" oil was poured in to the mains in an attempt to lay the dust in this manner. Subsequent tests indicated that some of this "wetting" oil was picked up by the gas stream and carried to the pilots.

It was apparent by this time that drastic means would have to be taken to remove the dust from the gas stream.

Three Types Studied

We investigated three general types of dust scrubbers which are suitable for use at regulating stations. Each type described has advantages over the others under certain circumstances. In describing each type I will try to list the advantages and disadvantages as well as giving operating data and capacities. The three specific types are as follows:

(1) Dollinger Sta-New Filter made by Dollinger Corporation, Rochester, New York. This is a dry filter using a fine type pad cloth filter.

(2) Aerotec filter made by the Aerotec Corporation, Greenwich, Connecticut. This is a dry type scrubber using a series of small tubes, which induce centrifugal force, to remove undesirable material.

(3) Blaw-Knox Gas Cleaner made by Blaw-Knox Division of Blaw-Knox Company, Pittsburgh, Pennsylvania. The Blaw-Knox gas cleaner is a liquid washing type scrubber designed for the re-

Paper presented at AGA Operating Section, Distribution, Motor Vehicles Conference, Memphis, 1951.

moval of entrained solids from the gas stream. The cleaner consists essentially of a vertical tank containing an oil reservoir, scrubbing section, primary oil separator, and final mist extractor.

To solve our problem, we installed a Sta-New filter ahead of the district regulator, thus protecting the low pressure district formerly mentioned and also the medium pressure district. Tests indicated that this filter was effective for about five days when dust was detected beyond it. It was opened and found to be well coated with line dust with evidence that some dust had penetrated through it. The filter was cleaned and replaced and arrangements were made with the Dollinger Corporation to provide a filter which would remove even finer particles. The original filter was supposed to remove all dust down to two microns diameter, emphasizing again the fineness of the material that was coming through the pipe line. As soon as the filter was installed, the complaints of dust dropped off very sharply and within a few days disappeared entirely.

Since that time, we have installed another Sta-New filter at another district regulator and have installed two Aerotec filters at points along the line where higher flows are encountered. We plan to install additional filters next spring at regulating station supplying a large territory.

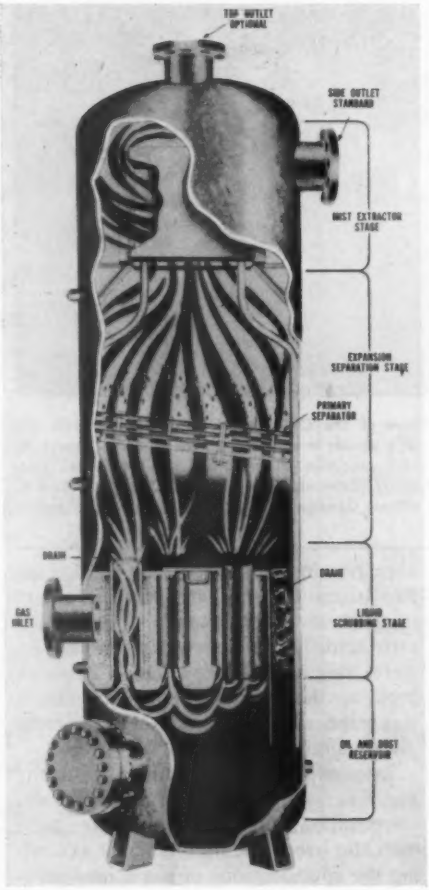
I do not mean to imply that these are the only dust filters on the market.

The description of the three types of filters as furnished by their manufacturers follows.

Sta-New Gas Filter

In 1920, Louis L. Dollinger began the manufacture of filters. His first product was an air intake filter, one of the first of its kind, designed to protect the wearing parts of internal combustion engines. Dollinger called it the "Protectomotor," since it was primarily designed to protect automobile motors.

Meeting a definite need and performing a real service, the "Protectomotor" was a success from the start. From this pioneer filter it was a logical step to the designing of a complete line of filters to meet every industrial, ventilation, and air conditioning need. Another descriptive term "Staynew" was coined which, in a single word, explained the object of the filters—to preserve newness by keeping out dirt, dust, and soot, etc. The heart of their original "Protectomotor" filter was its radial fin design of filtering element or insert, which provided a maximum of active filtering area in relation to its physical dimensions, and the size of the pipe line. This still ranks as one of the outstanding engineering contributions to the advancement of industrial filtration.



Blaw-Knox standard gas cleaner.

For some period of time it has been commonly assumed that natural gas is clean and that the pipe lines in which it is conveyed from its source in the ground to the ultimate users are likewise extremely clean. The conception of gas being cleaned is assumed because at all compressor stations along the line there are employed gas scrubbers which remove a great percentage of the dirt, but not all of it, and when pipe lines are new they are comparatively clean, but with use slowly oxidize with somewhat the same action as takes place in compressed air lines.

Recently, however, considerable problems have arisen in conjunction with controls, meters, regulators, and gas burning equipment, as well as damages to cylinders, rings, and valves of internal combustion engines employing natural gas as fuel. It was a natural development for the industry to turn to Dollinger Corporation to supply a mechanical filter to remove the remaining dust, thus assuring long carefree operation of equipment. The Dollinger Corporation has designed a series of "Staynew" gas filters which will remove over 99 per cent of the iron oxide and dirt from the gas stream. Employing their radial fin principle they can put into normal size steel shells a very large amount of square feet of filtering area. They developed a special type filter media which is composed of fibers of wool, rayon, and cotton. The construction of the individual fibers as well as the process employed in pressing them together, gives an almost unlimited surface when viewed under the microscope. This surface is able, both by impingement and induced electrostatic charges, to move the iron oxide particles from the gas stream to the individual strands and fibers, and then by tenacles on these strands and fibers the particles adhere completely.

Principle of Operation

Gas enters the shell of the filter where a deflector cup directs the flow of gas together with water, oil, and dirt to the walls of the housing and then downward at high velocity into the base, where water, oil, and heavier particles of rust, scale, and dirt are deposited. The gas having been mechanically cleaned, rises at low velocity through the radial fin filtering insert, which removes the lighter gas-borne material. The filtering media employed removes all of the dust down to very small particle size in the order of two to three microns. The efficiency and operating interval depend upon the velocity of gas through the media and considerable experience has shown that this value should be from 5 to 25 feet per minute, depending upon where in the natural gas system the filters are installed.

(1) Low resistance. The mechanical separation of heavier dirt particles combined with the extremely large active filtering media, made possible by the radial fin insert, maintains very low velocities with resultant unusually low resistance to flow.

(2) Continuous Operation. The design of pipe line filters eliminates the need for frequent cleaning, first because there is a liberal amount of space in the bottom housing for accumulated dirt and condensate and, second, because the radial fin design of the filtering element provides an extremely large active filtering area in relation to the space which it occupies.

(3) Accessibility. The interior parts of the "Staynew" pipe line filter are easily exposed for inspection and cleaning. Loosening and removal of body flange bolts permit removal of the lower housing without the necessity of breaking any pipe line connections.

(4) Dry Scrubbing. Hence no carry-over of scrubbing liquids.

(5) Compactness. This unit is small and light in relation to its capacity due to the fin type filter.

(6) Low first cost. Since the "Stay-

In a pleasant picture are—Three newly named officers of The Ohio Fuel Gas Co. shown with two top officials of The Columbia Gas System, Ohio Fuel's parent corporation. Left to right: Stuart M. Crocker, Columbia's chairman of the board and chief executive officer; Allan W. Lundstrum, vice-president and general manager of Ohio Fuel; William N. Grinstead, president of Ohio Fuel; Earl C. Overbeck, Ohio Fuel chairman and chief executive officer; George S. Young, president of Columbia.

new" scrubber is small and compact, with the minimum of parts, its low cost is evident.

(7) Adaptability to special situations. Since the filtering media is installed in a gas tight steel case, it can be seen that special designs to meet almost any requirement can be made by simple changes in the steel shell.

"Staynew" filters are made in a wide variety of sizes and at any working pressure desired up to 2500 pounds. Installations have been made on capacities for individual filters up to one hundred million cubic feet per day and pressures up to 2000 pounds and designs are available for even larger capacities and higher pressures. Where it is desired two or more units may be installed in parallel. It is not necessary to maintain the care to obtain equal distribution of load between filters as in other types as the "Staynew" filters are efficient throughout their entire range up to the full capacity of the filter.

Aerotec Gas Scrubber

The development of the Aerotec tube had its inception in the experience and background of the Prat-Daniel Corporation. They made a highly efficient Thermix recirculator using a fan to produce a cyclone effect for use in removing dust from air conditioning systems and industrial applications. The next step was the development of the Thermix ceramic tubular dust collector, which was a unit requiring less space and no moving parts.

The recent world conflict made it apparent that fast mobile warfare presented an entirely new problem in air cleaning. The urgency that the problem be solved immediately could of course not be overestimated. Engines on tanks and planes moving through or over dusty terrain were destroyed rapidly by abrasive dust entrained with intake air. Provisions to eliminate this dust were inadequate. Viscous type filters, used satisfactorily to meet civilian needs, were overloaded. They had a pressure build-up that impaired efficiency and it was impossible to service them properly under combat conditions.

Intensive research coupled with the previous background of the Prat-Daniel Corporation achieved the Aerotec tube with the precipitating efficiency exceeding the specifications of the armed services. The first design was 1½ inches in diameter, which allowed the company to assemble a unit that could be installed in a very limited space. The unit is self-cleaning, with a continuous dust discharge, thus obviating the increased weight which normally accrues to dust storage.

Several applications in designs were completed with the 1½ inch diameter tube, before special application was encountered which required a tube of greater capacity.

At this point the company produced a two inch diameter unit. The efficiency is substantially that of the smaller tube. This tube designated as design #2 was introduced and accommodated to numerous civilian industrial applications, including scrubbing of gas.

An Aerotec gas scrubber consists essentially of a series of Aerotec tubes, the number depending upon the volume of gas to be handled. These tubes are assembled in a shell and held in place by tube sheets. The shell is fabricated of pipe of proper size and thickness to withstand the operating pressure. Inlet and outlet connections are welded on the shell.

The Aerotec tube itself is essentially a tube within a tube. Gas enters the tube about two-thirds of the distance up at points 180° apart as shown by the arrows and at a tangent to the inner tube. The gas travels between the two tubes in a circular motion to the bottom of the inner tube, where the centrifugal force drives out any dust and the clean gas rises through the inner tube. The dust is discharged downwards to a suitable dust collector.

ADVANTAGES OF AEROTEC GAS SCRUBBERS

1. Efficient gas scrubbing without oils or liquids.
2. Removal of all entrained liquids and dust indiscriminately.
3. Dry scrubbing, hence no carry-over of scrubbing liquids.
4. No oil "stealing" when units are operated in parallel.
5. Not subject to overload due to operating principle involved.
6. Much smaller and lighter than any other gas scrubber sold today.
7. Easy to install due to light weight and piping simplicity.

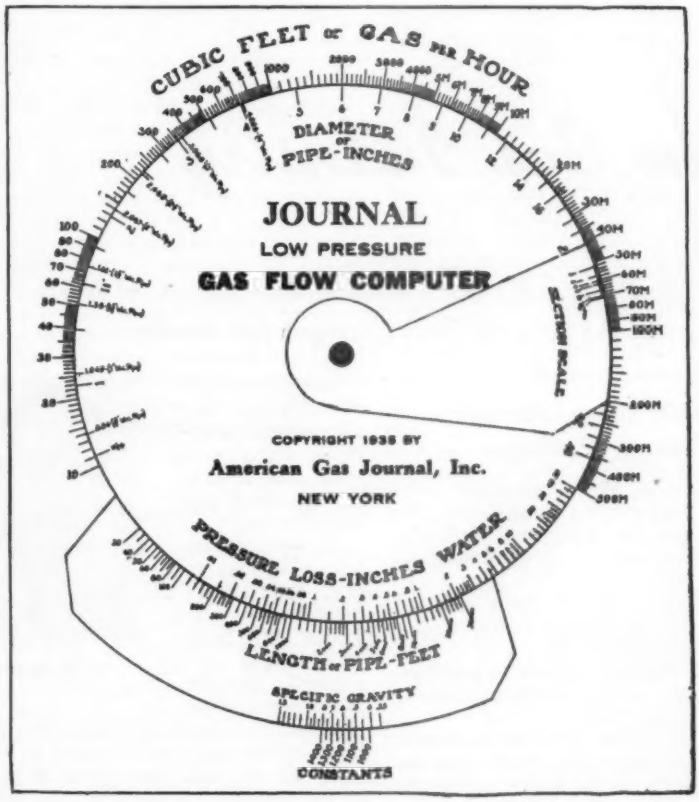
Limitations as to size and capacity of Aerotec oil and gas scrubbers are practically non-existent. Units of one hundred million standard cubic feet of gas per day capacity are in use on transcontinental pipe lines at compressor stations. At some points, as many as five of these units have been manifolded to give a capacity of four hundred million to five hundred million standard cubic feet per day capacity.

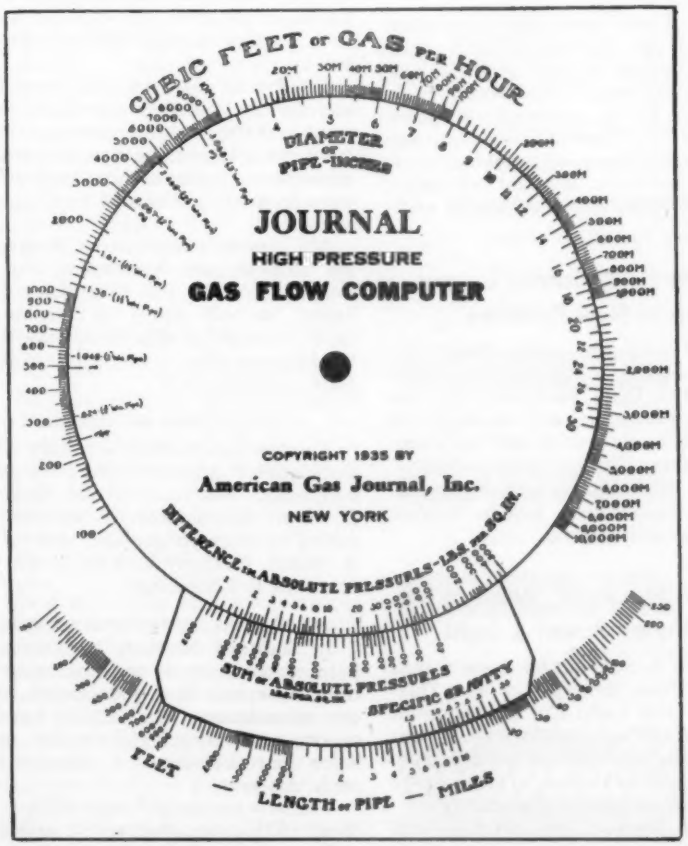
The scrubbers are made in two types, the vertical gas scrubber for the removal of dry dust, and the horizontal gas scrubber for the removal of both dry dust and entrained liquids. The capacity of the scrubber depends on the number of tubes, and the operating pressure. Greatest efficiency of dust removal occurs when a pressure drop of two pounds to five pounds is maintained across the tubes. A pressure chart will be furnished by the manufacturer with instructions in selecting the proper size scrubber for any given installation. The scrubbers can be furnished for any design pressure from 250 pounds per square inch gauge to 1500 pounds per square inch gauge. All Aerotec gas scrubbers comply strictly with API-ASME construction, bear the API-ASME code stamp. When specifically instructed these gas scrubbers can also be supplied conforming to ASME code construction.

Blaw-Knox Gas Cleaner

The practice of using oil for the purpose of controlling or removing undesirable contaminants in gas is older than the natural gas industry. Since oil scrubbing was a common practice in the manufactured gas industry to remove naphthalene and other gum forming contaminants, it was natural that this

(Continued on page 44)





JOURNAL

Gas Flow

COMPUTERS

FOR LOW PRESSURES:

Cubic feet of gas per hour . . . . . 10 to 500M
Pipe diameters . . . . . ¾" to 48"
Pressure loss (inches) . . .01 to 10
Specific gravities . . . . . 1.5 to .35
Constants . . . . . 1400 to 1000
Pipe length (feet) . . . 30 to 30,000
Price $5.00

FOR HIGH PRESSURES:

Cubic feet of gas per hour . . . . . 100 to 10MM
Pipe diameters . . . . . ¾" to 30"
Difference in absolute pressure to . . . . . 500 psi.
Sum of absolute pressures . . . 20 to 2,000 psi.
Specific gravities . . . . . 1.5 to .35
Pipe length (feet) . . . 100 to 5,000
Pipe length (miles) . . . . . 1 to 250
Price $5.00

The computers are printed on heavy durable plastic, enclosed in leatherette cases with complete instructions for their use.

PUBLISHED AND SOLD ONLY BY:

AMERICAN Gas Journal

205 E. 42nd Street,
New York 17, N. Y.

News of the Gas Industry

B. C. Adams Jr. Elected V-P Of Texas Gas Transmission

B. C. Adams Jr.

B. C. Adams, Jr., has been elected vice-president of Texas Gas Transmission Corp. in the company's gas supply department, it was announced by W. T. Stevenson, President.

Mr. Adams has served as assistant to the executive vice-president since he joined the company in May 1950. In addition to his duties of negotiating and contracting for natural gas reserves, he will continue as vice-president of Louisiana Natural Gas Corp. and Texas Northern Gas Corp., gas-gathering subsidiaries of Texas Gas in the southwestern Gulf Coast area of Louisiana.

Prior to joining Texas Gas, Mr. Adams was, for two years, a vice-president of Trunkline Gas Supply Co. formerly of Dallas, Texas. During World War II he served in the Petroleum Administration for War as chief of the natural gas section. Previously, he had served as assistant to the president of Cities Service Gas Co. in Oklahoma City, and assistant to the general superintendent of Oklahoma Natural Gas Co.

Edward T. Bowers has been elected comptroller of Texas Gas Transmission.

Cooper-Bessemer Engineers Are Advanced

Several changes in Cooper-Bessemer's engineering organization have been made public by Ralph L. Boyer, vice-president and chief engineer.

In addition to Mr. Boyer and E. Frederick, assistant chief engineer, the Cooper-Bessemer's new office of chief engineer now includes: T. O. Kuivinen, R. F. Kymer and W. R. Crooks as chief engineer's assistants.

Under Cooper-Bessemer's new engineering management plan, technical matters will be handled by Mr. Kuivinen. Liaison or coordinator of activities between engineering and production will be directed by Mr. Kymer. Mr. Crooks will assist in a general administrative capacity as well as direct his efforts in research and development projects.

James M. Beall Heads Information Bureau of AGA As Several Staff Changes Are Made

J. M. Beall

American Gas Association has announced a series of staff changes in natural gas, research and publicity fields.

In preparation for expansion of the association's publicity program, James M. Beall has been appointed director of a new public information bureau replacing the publicity bureau and the bureau of publications. He has also been made secretary of the association's publicity and advertising committee. George A. McDonald has been appointed manager of press relations in the public information bureau with particular emphasis on financial news.

Eugene D. Milener has been made secretary to both the natural gas department and the manufactured gas department. In addition, he has assumed administrative duties at headquarters that were formerly performed by George H. Smith.

Mr. Smith continues as director of the natural gas department and will maintain contact with its policies. Eventually, he will move to Washington, D. C., to manage the Association's new Washington office at 603 Albee Building, 1426 G Street, N.W.

COORDINATOR OF RESEARCH

Thomas Lee Robey, secretary of the association's general research planning committee, has received the additional duties of coordinator of research. Assisting as research engineer will be Roy A. Siskin, formerly with the AGA Laboratories in Cleveland.

SECRETARY, OPERATING SECTION

J. Stanford Setchell has been appointed secretary of the Operating Section, American Gas Association, effective immediately. Mr. Setchell has been serving as acting secretary of the section since the retirement of A. Gordon King early this year.

The new secretary joined AGA in October 1936 as assistant to the utilization engineer and in September 1940 was advanced to assistant utilization engineer.

Columbia System Announces Executive Changes

The Columbia Gas System, Inc., and Columbia Engineering Corporation, the subsidiary service company, have announced a series of appointments to executive positions.

E. R. Conner moves from assistant vice-president to vice-president of Columbia Engineering Corp.

James S. Phillips, director of purchasing, becomes vice-president of Columbia Engineering Corp.

Charles H. Mann becomes treasurer of Columbia Engineering Corp. and assistant treasurer of the parent company.

Alan A. Cullman was elected to the newly created post of controller of Columbia Engineering Corp.

Morton Lewis was elected assistant treasurer of The Columbia Gas System.

Others named to new posts in Columbia Engineering Corp. were:

Fred W. Batten, assistant vice-president; Leon M. Plasterer, assistant treasurer; Lawrence Vose, assistant treasurer; Albert V. Schwartz, assistant controller; Harry C. Davies, assistant general auditor.

H. E. Frome & Richard L. Lang Are in New Positions

H. E. Frome, Zanesville, Ohio, distribution district industrial sales manager for The Ohio Fuel Gas Co., has been named industrial sales manager for The United Fuel Gas Co. in Charleston, West Virginia.

Richard L. Lang, industrial sales engineer in Ohio Fuel's Toledo district, will succeed Mr. Frome.

Schmidt Is Manager, Western Div. Of Dayton Power & Light

Raymond A. Schmidt has been named western division manager of The Dayton Power and Light Co. Mr. Schmidt replaces C. Earl Lakin, who was elected a vice-president of the company and has moved to Dayton to take charge of all of the company's gas operations.

The new division manager has been assistant to the president since April 7, 1947.

S. W. John Heads Rate Dep't Of Commonwealth Services

Stuart W. John, public utility rate consultant, has been appointed head of the rate department of Commonwealth Services Inc., effective June 1, according to an announcement by Granville H. Bourne, president.

Mr. John has been active in utility rate matters since 1927. He was associated with Dallas Power & Light Co. for 16 years and was head of that company's rate and economic research department in 1943 when he left for a period of service in the Navy, following which he joined Ebasco Services in 1947.

Mr. John was graduated from the Massachusetts Institute of Technology in 1926, in electrical engineering, followed by advanced work in accounting, finance and economics at New York University.

Rheem Mfg. Appoints C. H. Horne Sales Manager, Refrigerators

Rheem Manufacturing Co. has appointed Carl H. Horne sales manager of the refrigerator division. The action is in line with Rheem's announcement last November of plans to develop and market a gas-operated refrigerator.

This program has progressed to the point where a sales division is being established to plan distribution of the refrigerators. Mr. Horne will head this division and develop a sales organization.

Mr. Horne, well known in the gas industry, has been active in the American Gas Association and the Southern Gas Association for a number of years. Currently he is a member of the AGA executive committee, chairman of the residential section, member of the general promotion and planning committee, and of the national advertising committee. He was president of the Southern Gas Association during 1950-51. Prior to his move to Rheem he was vice-president of the Alabama Gas Corporation at Birmingham.

Texas Eastern Starts New Division And Makes Personnel Shifts

E. R. Cunningham, vice-president of Texas Eastern Transmission Corp., has announced, effective immediately, formation of a new operating division to be known as Division 5. This division will embrace the area from Kosciusko, Miss., to the northern boundary of Kentucky, with the division office to be located at Lebanon, Tennessee. "Formation of the new division permits an extensive series of promotions affecting operating personnel," Mr. Cunningham said.

"Need for the new division," he added, "developed from Texas Eastern's current $114,300,000 expansion program, largest single project of which provides for a new 30-inch natural gas transmission line from Kosciusko, Miss., to Connellsville, Pa."

Edward J. Kennelly, presently the division manager at Downingtown, Pa., will become division manager of Division 5, and William Falleaf, formerly assistant division manager of Division 4 at Baytown, Texas, will become assistant division manager at Lebanon.

Paul L. Hughen, until now division manager at Baytown, will replace Mr. Kennelly as manager of Division 3 at Downingtown, Pa.

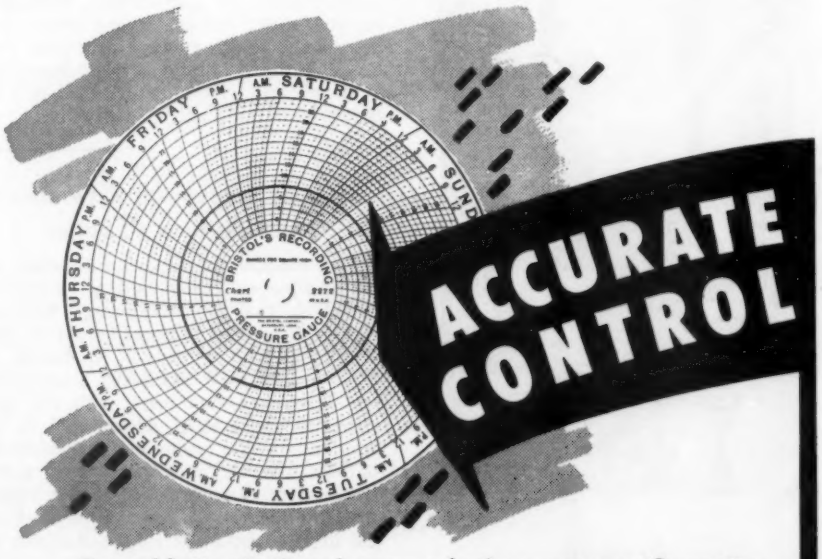
William C. Britt, former assistant division manager at North Little Rock, Ark., will transfer to Baytown, Texas, as division manager. Earl Humble will move up from division engineer to assistant division manager at Baytown.

At North Little Rock, Robert S. Cooper, previously division engineer, will assume the duties of assistant division manager.

Cluff Named Publicity Director Of Portland Gas & Coke

A new position at Portland (Ore.) Gas & Coke Co. was filled in May by Carl E. Cluff, formerly managing editor of the *Sandy Post*, who was named publicity director, responsible for all phases of public information on company matters.

Mr. Cluff has had wide experience with northwest publications. Prior to his work on the *Sandy Post*, he was circulation manager of the *Daily Olympian* at Olympia, Wash., and a reporter for the *Gresham Outlook* and *The Dalles Chronicle*.



Reynolds Service Regulators are built to meet specific requirements—years of operation in the field through a complete range of operating conditions have proved not only their superiority but their durability. With parts so precisely machined for each model that they are completely interchangeable. The accuracy you require in performance is assured.

MODEL 10

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accessible as to be interchangeable without removal from pipe line.

MODEL 20

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accurate as to permit complete interchangeability in shop.

MODEL 30

For horizontal or vertical connections, with or without removable valve pocket. Available with either Spring or Dead Weight adjustment. With or without Mercury or Dead Weight Safety Seal or diaphragm operated relief valve.

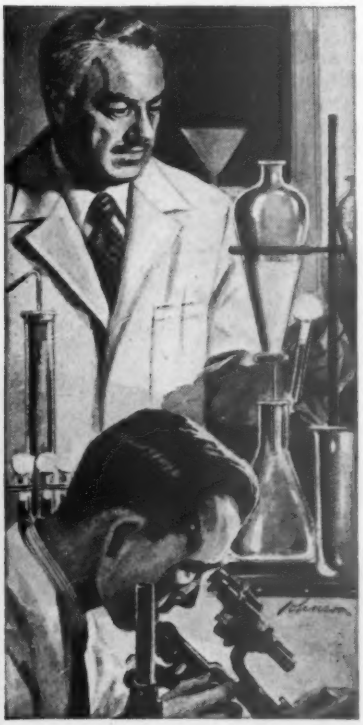
Reynolds Gas Regulator Co.

ANDERSON, INDIANA, U. S. A.

GAS CONTROL SINCE 1892

How your dollars

STRIKE BACK AT CANCER



through

RESEARCH

that saves lives

In the past six years, the American Cancer Society has devoted $16,856,000 to the support of *Research*, chief hope of millions of threatened cancer victims. Science has given us improved techniques in diagnosis and treatment that have saved thousands of lives. Your contribution to the Society also supports *Education* and *Service* to the cancer patient.

AMERICAN CANCER SOCIETY

Regional Stockholder Meetings Are Successful According to Consumers Power Co.

Keen stockholder interest in the progress and growth of their investment was evidenced by the more than 4,400 shareholders who attended Consumers Power Company's recently concluded series of regional stockholders meetings held in ten cities in the company's service area. The number in attendance represented approximately 20 per cent of the total number of stockholders living in Michigan.

Meetings were held in Bay City, Battle Creek, Flint, Grand Rapids, Jackson, Kalamazoo, Lansing, Muskegon, Royal Oak and Saginaw—some of the larger communities in Consumers' Michigan service area. Among those who conducted the meetings were president Justin R. Whiting, first vice-president Dan E. Karn and vice-presidents Robert P. Briggs and James H. Campbell.

Members of the executive staff appeared at the meetings to report on the company's natural gas and electric operations and growth during 1950 and the company's $48,000,000 1951 construction program. Consumers Power Company's new sound-color movie "Meet Outstate Michigan" was shown, as an illustration of the company's continuing industrial development program.

The regional meeting idea was originated at Consumers Power Company by President Whiting in 1949 when four meetings were held. In 1950 the number increased to seven and this year to ten.

This year's sessions were acclaimed as the most successful from every standpoint and, company officials believe, were indicative of the ever-increasing interest among stockholders in the operations and progress of the company.

Moeller Retires and Lawrence Succeeds as V-P, SoCal

The election of Grove Lawrence to the position of vice-president, Southern California Gas Co., to succeed William Moeller, Jr., who retired on July 1, was announced by President F. M. Banks.

A graduate of Stanford University, Mr. Lawrence has been with the gas company since 1925. He served as an engineer in the company's operations in Taft, Ventura, and Newhall for a period of 10 years. In 1938 he was made superintendent of transmission at Taft, and in 1943 he came to Los Angeles as manager of the company's compression and storage department. When the company's gas plant in Los Angeles was converted to the manufacture of butadiene as part of the government's synthetic rubber production program in 1943, he became manager of the butadiene production department. Following the war he returned to his former post and was made assistant vice-president with headquarters in Los Angeles.

At the time of his retirement on July 1, Mr. Moeller had completed more than 44 years in the gas business. A native of New York and a graduate of Stevens Institute of Technology he joined the Kansas Natural Gas Co., Independence, Kansas, in 1907 as an engineer.

In 1914 he took the position of chief engineer for the Midway Gas Co. in Taft, California, a company which was then engaged in transporting natural gas from oil fields around Taft to Glendale through the first long-distance pipe line built in California. Later he became general manager of this company, and upon its merger with the Southern California Gas Co. in 1922, he was made manager of natural gas production and transmission. He became a director of the company in 1929 and was elected vice-president in 1932.

Mr. Moeller was elected a director of the Pacific Coast Gas Association in 1924; was appointed chairman of the Technical Committee of the association in 1930; and served as president in 1934 and 1935.

He was also chairman of the Natural Gas Section of the American Gas Association.

Rockwell Appoints Rowand General Manager

Norman W. Rowand has been made general manager of the Pittsburgh plant of Rockwell Manufacturing Company's meter and valve division, according to an announcement by L. A. Dixon, vice-president.

Mr. Rowand was formerly chief industrial engineer for the Pittsburgh-Dubois division, and plant manager of the regulator division.

General American Transportation Appoints Ben King Duffy

General American Transportation announces that Ben King Duffy, sales engineer, has been appointed district sales manager of the plate & welding division for the Pittsburgh district.

Mr. Duffy will have charge of sales for such General American products as are fabricated by the company's plate & welding division, as well as Wiggins conservation structures and Wiggins gas holders.

Booklets on Diaphragms Issued By Vulcan Rubber Products

A new illustrated brochure has been released by Vulcan Rubber Products, Brooklyn 20, detailing properties and designs of synthetic coated diaphragms for all types of gas meters.

The company has also released an illustrated folder describing molded diaphragms for use in all types of regulators, governors and controls.

Frank W. Thompson Elected V-P Of 3 Michigan Companies

Frank W. Thompson has been elected vice-president of American Natural Gas Service Co., Michigan Consolidated Gas Co., and Michigan-Wisconsin Pipe Line Co.

Mr. Thompson will have charge of all rate matters for the three companies.

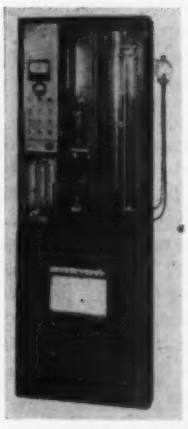
Mr. Thompson is registered in the fields of mechanical, electrical and petroleum engineering in the States of California and Michigan. He has had experience in the production and processing of natural gas in the field, and has been employed as an engineer by the California and Michigan Public Service Commissions and the Federal Power Commission.

Following graduation from the California Institute of Technology in 1929 with the degree of Bachelor of Science in Mechanical Engineering, Mr. Thompson pursued courses in chemistry, accounting, and law. He was employed at various times by Standard Oil of California, General Petroleum, and Los Angeles Gas and Electric.

He is author of a number of engineering articles and wrote the portion of the Federal Power Commission's report on the natural gas investigation relating to natural gas reserves and the practices and problems of producing, gathering, and processing natural gas.

He has been associated with American Natural Gas Service since February 1950.

New Method of Adsorption Fractionation Explained



New Fractionator

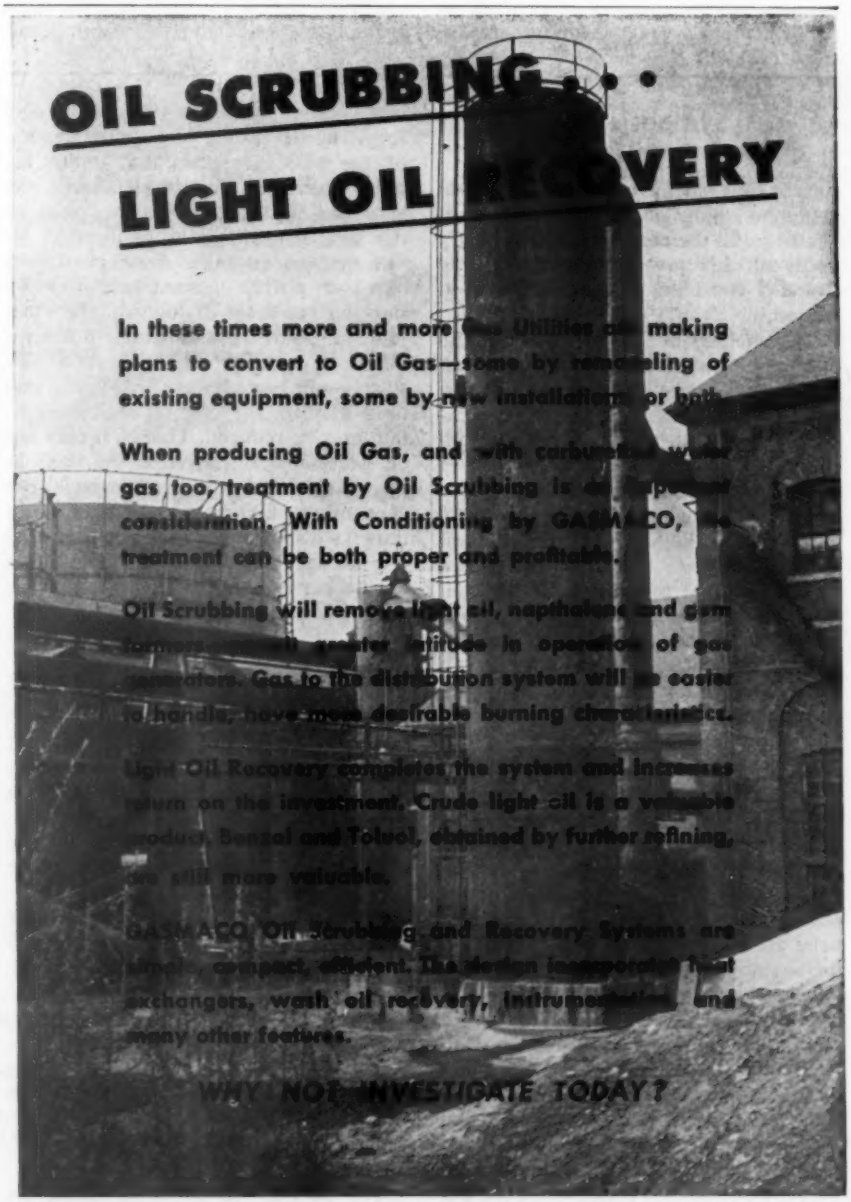
Lloyd V. Guild, director of research of Burrell Corporation, Pittsburgh, introduced a new simplified method of adsorption fractionation to gas industry representatives attending the 6th Annual Short Course in Gas Technology at the Texas College of Arts and Industries. Held May 30 through June 1 at Kingsville, Texas, the course was sponsored by the Southern Gas Association to acquaint members with recent technological developments within the industry.

The new method of adsorption fractionation is the result of more than ten years of research and experimentation in the Burrell laboratories. Incorporated in one self-contained piece of laboratory apparatus, the method provides a rapid and accurate analysis of light hydrocarbon gases through and including pentanes, Mr. Guild said. Gases are separated, identified and measured by volume of separated fractions. Separation is by physical adsorption.

Identification is made by measurement of the thermal conductivities and the volume of each fraction is arrived at by determining the change in pressure of an evacuated system. Accuracies of the order of 0.2 per cent are obtained. Identifications and measurements of the gas fractions are recorded on a potentiometer, so that a complete and automatic record of each analysis is available to the operator.

Contrasted with previously available methods requiring from six to eight hours, the new Burrell adsorption fractionator is said to provide analysis in from one to three hours with approximately 300 milliliters of sample being all that is required. Gases containing predominant light fractions, which have presented difficulty with other methods, may be analyzed reliably. Operators need not be skilled. No liquid air nor other refrigerants are needed. An electrical connection is the only requirement for immediate operation.

Dimensions are 3 feet wide x 2 feet deep x 6 feet high. Officially unnamed as yet, the apparatus is currently referred to as the "new Burrell adsorption fractionator."


OIL SCRUBBING . . .
LIGHT OIL RECOVERY
In these times more and more Gas Utilities are making plans to convert to Oil Gas—some by remodeling of existing equipment, some by new installations or both.
When producing Oil Gas, and with carburetted water gas too, treatment by Oil Scrubbing is an important consideration. With Conditioning by GASMACO, the treatment can be both proper and profitable.
Oil Scrubbing will remove light oil, naphthalene and gum formers, result in greater latitude in operation of gas generators. Gas to the distribution system will be easier to handle, have more desirable burning characteristics.
Light Oil Recovery completes the system and increases return on the investment. Crude light oil is a valuable product. Benzol and Toluol, obtained by further refining, are still more valuable.
GASMACO Oil Scrubbing and Recovery Systems are simple, compact, efficient. The design incorporates heat exchangers, wash oil recovery, instrumentation, and many other features.
WHY NOT INVESTIGATE TODAY?

THE GAS MACHINERY COMPANY
16114 WATERLOO ROAD
CLEVELAND 10, OHIO

Designers • Fabricators • Erectors
Gas Plant Equipment and
Industrial Furnaces
THE GAS MACHINERY CO. (Canada) Ltd
HAMILTON, ONTARIO

AGA Announces Publication Of Research Bulletins

Two research bulletins and a progress report have been issued by the Committee on Domestic Gas Research of the American Gas Association under the research division of the AGA Promotion, Advertising and Research (PAR) Plan.

Research Bulletin No. 63 is titled "Fundamentals of Heat Transfer in Domestic Gas Furnaces" and it offers the results of studies on heat transfer from gas flames on various metal surfaces in domestic gas furnaces.

Thermocouple type elements for automatic ignition systems, particularly as applied to gas water heating, are reviewed and discussed in Research Bulletin No. 64. A previous report had been issued on thermal elements used in automatic ignition systems for gas water heaters which dealt with flat strip bimetallic thermal elements.

The Committee on Domestic Research also issued a report titled "Comparative Study of Various Methods of Cooking." The investigation report included a study of available information pertaining to cooking operations with different fuels. Infra-red cooking, high frequency induction dielectric cooking, uncooked and pre-cooked frozen food cooking were also included in the study.

The report points out that despite variations in cooking procedures, there are only two basic cooking methods employed in the home. These are dry heat cooking and moist heat cooking.

Gas and electric cooking with conventional equipment can provide a satisfactory product when proper conditions are observed. Electronic cooking appears to have no immediate future in domestic cooking, the report states.

Selas Issues New Booklet

Petroleum heat processing, using radiant gas heat in tubular heaters, is the subject of a new bulletin issued by Selas Corporation of America, Philadelphia.

"Selas Gradiation Heater for the Petroleum Refining Industry" describes the heating principle which distributes radiant heat uniformly around and along the tubes.

Synthesis Gas

(Continued from page 14)

runs or runs in which all but one variable could be rigidly controlled. This is reflected in all the data and is particularly pertinent in any discussion of the amounts and kinds of sulphur found in the gas.

The analyses of the gases made in the pilot-plant gasifier to date indicate that no unusual forms of sulphur exist and that the demands made in the purification process will be similar to those encountered in the manufacture of water gas from coal in fixed beds.

There are definite trends indicating that the use of high steam : coal ratios at the higher steam temperatures reduces significantly the proportion of the coal sulphur that appears as organic sulphur in the gas. This reduction in organic sulphur content, if borne out by future work, might constitute a credit as regards purification costs.

EFFECT OF CYCLONIC ACTION

It was shown earlier (Fig. 7) that the percentage of coal ash remaining as slag increases in an almost straight-line relationship with the percentage of carbon gasified. A possible explanation of this phenomenon is that some of the coal particles are held on the wall of the generator in molten ash and gasified by the swirling gases moving past the surface. If the reaction were being carried on in a complete entrainment system, no ash would be deposited in the generator, and increasing percentages of carbon gasified would be coupled with increasing percentages of ash in the material carried over in the gas stream. No such linear relationship is found when the ash content of the residues is compared with gasification efficiencies.

The presumed hypothesis that some of the coal is thrown to the wall by cyclonic action would also explain the continued formation of gas after the coal feed is shut off. Estimating centrifugal force exerted on the particle by rotation of the gas, it appears that under the most severe conditions all except the very fine particles might be driven to the gasifier wall. Coal gasification by this method or under these conditions has two distinct advantages: (1) By slagging out most of the ash, the dust-removal and waste-disposal problems might be greatly simplified, and (2) since larger particles are held in the slag until gasified, the cost of coal preparation may be reduced. That is, it may not be necessary to pulverize the coal as finely as that used in these tests (90 per cent minus 200-mesh). In fact, later tests have shown that much coarser coal can be used without appreciable effect on the performance of this gasifier under the conditions used.

VALUE OF 2,900° F. STEAM FOR PRODUCTION OF SYNTHESIS GAS

Fig. 8 shows the value of steam at 2,900° F. for use in the production of synthesis gas. Its value is determined by the costs of oxygen and of coal. Fig. 8 is based on the average of all the high-temperature steam runs and 11 of the low-temperature steam runs, eight of the latter being omitted because the steam: coal ratio was too high and, hence, the oxygen requirement too high. The averaged data are given in table 2.

TABLE 2.—Requirements per 1,000 SCF. of ($CO + H_2$) produced.

Steam temperature, °F.	Coal, lb.	Steam, lb.	Oxygen, SCF.	Thousands of Btu. above 400° F. in exit gas
2,904	33.4	81.2	170	52.8
238	42.3	29.1	394	42.5

The data in the table show that the use of 81.2 pounds of steam superheated to 2,900° F. effects a saving of 223 SCF of oxygen and 9 pounds of coal and produces an additional 10,000 Btu in the exit gas. If the extra heat in the exit gas is credited at coal cost, the value of the steam may be expressed in terms of oxygen and coal saved; and, if the oxygen and coal costs are known, the value of steam for the production of synthesis gas may be found. If the value of steam thus found is greater than the cost of producing and superheating the steam, the use of superheated steam is justified.

An additional credit that could be mentioned for use of high-temperature steam is the high hydrogen : carbon monoxide ratio of about 1.8, which is that reported to be in use at the commercial-scale synthetic-liquid-fuel plant at Brownsville, Texas.

Whether or not use of highly superheated steam is indicated for any given plant depends entirely on specific conditions at that plant. A later publication is planned to give further information bearing on costs of superheating steam to extreme temperatures.

Future Work

Pulverized coal may also be gasified by a mixture of air and steam which has been superheated to a high temperature, for example, in the Royster pebble stove. By this means, an alternative process is presented for making synthesis gas avoiding the necessity of an oxygen plant. This method may also be used to make from pulverized coal a high-Btu producer gas or a gas for the synthesis of ammonia. Theoretical calculations have shown that the hydrogen plus carbon monoxide : nitrogen ratio may be varied over a wide range and that the ratio of 3, desired for ammonia synthesis, may be easily obtained. This should be confirmed experimentally.

Ross C. Cornish Is Dead

Ross C. Cornish, who was retired from business, died suddenly of a heart attack on June 21 in Oshkosh, Wisc. He was a former chairman of the technical section of the American Gas Association, and was instrumental in the construction of gas plants in Panama and Colon.

In 1935 he was associated with W. E. Steinwedell in the laying of the natural gas pipe line to Minneapolis, and the conversion of plant and appliances to the new gas.

During his career in the gas industry, Mr. Cornish was associated with these companies: Milwaukee Gas Light Co., American Gas Co. of Philadelphia, United Gas Improvement Co., Day & Zimmerman, Semet-Solvay Engineering Co., and the Gas Machinery Company, Cleveland.

Cooper-Bessemer Promotes

The promotion of I. W. Ferguson to manager, quality control, was recently announced by Dr. Hewitt A. Gehres, executive vice-president of the Cooper-Bessemer Corp.

"The new post of manager, quality control, is an outgrowth in Cooper-Bessemer's effort to improve manufacturing precision," explained Dr. Gehres. "Especially during a period of marked acceleration in production activity, as we are experiencing now, a carefully defined management authority of this kind will enable Cooper-Bessemer to maintain uniform standards of manufacturing quality in its engine and compressor building plants.

At the same time, E. C. Phelps has been elevated to assistant works manager, formerly held by Mr. Ferguson, according to P. R. Letz, Cooper-Bessemer works manager. Harold Johnson now becomes factory superintendent and Harry Cecsarini, supervisor of the routing and estimating department.

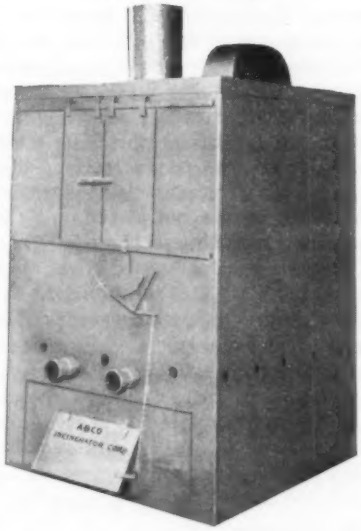
Index of Yields

(Continued from page 33)

did in years gone by. The insurance companies are drying up as a source of ready funds, due largely to the vagaries of the Federal government in its financial machinations. "We will have the money for good credit risks," insurance company sources told the writer some months ago, "but we will have to receive advance notice so that we can space our loans and allocate the amounts required."

Fulfillment of this prophecy is shown in the recent experience of one of the gas companies seeking money for expansion purposes. The sum will come initially from commercial banking sources, with the insurance company agreeing to "pick up the tab" for the loan about 18 months hence.

Incinerator Is Introduced By ABCo Corp.



A new, commercial, air-cooled, automatic, gas-fired incinerator that consumes wet or dry garbage and waste material has been placed on the market by the ABCo Incinerator Corp. of Cleveland says Arthur Bethardy, president of the company and designer of the incinerator.

The unit is of steel construction and takes little floor space when installed. It consists of an airtight, heavy gauge, steel casing interlocked at four corners with upright steel posts. A three-fold insulation system that keeps the heat within the incinerator is accomplished by an insulating material within the case, a two inch circulating air space and a refractory lining that is two inches thick.

A combination grate and burner assembly with a series of thirty-degree-angle openings produces a vertical jet flame that consumes wet or dry garbage, trash, rubbish, bones or anything that is burnable. The incinerator burns natural, manufactured, or mixed gases.

Lubricated Plug Valve Manual Issued by Nordstrom

A new manual with piping, wiring, mounting, and installation data for power operated Nordstrom lubricated plug valves has been issued by the Rockwell Manufacturing Co., Pittsburgh.

This bulletin is said to be the first complete compilation of technical data covering the use of pneumatic, hydraulic, and electric operators for lubricated plug valves.

Included are piping diagrams, arrangements for both side and top mounted motor controls, closing speeds, wiring data, and photos of actual installations.

A COMPLETE MAIN TREATMENT SERVICE

Prepare for Natural Gas

"FLUSHALL"	– Dust Removal
"SOLVALL"	– Liquid Phase Gum
"SEALALL"	– Joint Sealing
"WETALL"	– Dust Laying
"FOGALL H"	– Hot Fogging
"FOGALL C"	– Cold Fogging
"IRON HYDROXIDE"	– Purification

Discuss your problems with our engineers

GAS PURIFYING MATERIALS COMPANY, INC.

3-15 26th Ave., Long Island City, N. Y.

Cleaning Natural Gas

(Continued from page 36)

method should be tested as a means of controlling the dust problem that arose with the drying out of mains during the change-over to natural gas. The Blaw-Knox gas cleaner is a development of the oil scrubber to fit the needs of dust removal from the gas stream in distribution mains.

The advantages claimed for the Blaw-Knox cleaner are as follows:

(1) Complete dust removal, regardless of fineness or quantity.
(2) Capable of continuous operation.
(3) No accidental stoppage of gas flow.
(4) Low upkeep cost.
(5) Easy, simple maintenance.
(6) Delivery of dry, clean gas.

Description of Operation

The cut-away view on page 35 shows the principle of operation of the cleaner. The dirty gas is allowed to expand in the shell of the cleaner before entering the contactor tubes in order to allow the heaviest dirt particles and such foreign matter as welding scraps, rocks, etc. to drop out. The dirty gas is then intimately contacted with oil in the contactor tubes. The expansion zone immediately above the tubes allows the major portion of oil and dirt to drop out of the gas and return to the bottom of the oil reservoir where the dirt particles settle to the bottom. The separation of the remaining oil and dirt from the gas is accomplished by means of a primary separator which takes out the major portion and a mist extractor which removes the final traces of oil mist. The oil removed from the gas in each of these separators is returned to the bottom of the cleaner to be again picked up by the gas in the contacting section.

The liquid normally used in gas cleaners is a good grade of scrubbing oil having the following approximate specifications:

(1) Initial boiling point
Above 500° F.
(2) Distillation end point
Below 850°F.
(3) Pour
—30° F. to 0° F.
(4) Viscosity
100 seconds saybolt at 100° F.
(5) Gravity
25° to 35° A.P.I.

Installations may be made of either single or multiple unit settings. When two or more cleaners are to be operated in parallel, care should be taken in designing the piping to get as near equal gas distribution as possible. Detailed piping setups will be furnished by the manufacturer. The oil handling system should be designed to meet the needs of the particular installation. It should consist of equipment for settling the dirt out of the oil and for adding clean oil or new oil to the cleaners. With the installation complete, one cleaner at a time should be filled with oil until the level is approximately even with the bottom of the tubes. After the gas cleaner has been filled with oil, it should be purged with gas to remove all air and then brought up to line pressure. With the inlet valve completely open, the outlet valve is opened slowly until it is wide open. Care should be taken to see that the cleaner is not given extreme overload. If a by-pass valve has been provided, it is recommended that this valve be left partially open until the cleaner is completely on stream.

During the first few hours the cleaner is on stream, the scrubbing oil will absorb the various gas components until an equilibrium is established. This absorption is reflected in an expansion of oil volume, most of which will take place in the first hour. It is advisable to check the static oil level after the first fifteen minutes of operation, after the next half hour, and as often thereafter as necessary until the oil is certain to be at equilibrium with the gas. The amount

M-SCOPE Pipe Finder

LIGHTWEIGHT MODEL

One Man Operation On Every Application

HIGHLY EFFICIENT

IMMEDIATE SHIPMENT

Free Demonstration and Operating Instructions

Catalog No. 25M On Request

JOSEPH G. POLLARD CO., INC.

Pipe Line Equipment

New Hyde Park **New York**

ENGINEERING · REPORTS · VALUATIONS
DESIGN CONSTRUCTION
CONVERSION

- Specialists in natural gas, manufactured gas, oil gas, L-P gas, gas transmission lines and distribution systems. Expert witnesses. Reports on economics and for financing. Rate studies.
- Coal and coal carbonization problems.
- Our trained and experienced crews are ready for immediate service in any section of the country, to convert systems from manufactured gas to either natural gas or HiBtu oil gas.

Gas Construction & Service Co., Inc.

Worth 2-5120 30 Vesey Street New York 7, N. Y.

of this expansion depends on the gas and oil compositions, the pressure, and the temperature. If the static oil level goes above the arrow on the side which indicates the proper working level, the excess oil should be drained out. After the static level has stopped rising, it should be brought to the arrow. This static level should be checked at least once a week and should not be allowed to drop more than four inches below the arrow. The procedure for checking the static oil level is to shut off the gas flow, open all three valves on the gauge glass assembly, and let the oil rise in the gauge glass until it assumes a steady level. Allowance for initial expansion of the oil due to absorption is necessary only when adding large volumes of oil, as when filling or changing oil. Experience will dictate how important this factor is in each installation.

The operating oil level as shown by the gauge glass with the one quarter inch valve closed and the two gauge glass valves open shows the actual level of the oil when gas is passing through the cleaner. The operating level depends on the gas load as well as the amount of oil in the cleaner. It is useful for indicating the distribution of gas between cleaners in a parallel set-up, provided the cleaners have been filled to the same static level. It is also useful in a single cleaner installation to show the amount of oil in the cleaner if calibrated at various flow rates.

After a period of operating, depending on the quantity of dirt being collected, the oil in the gas cleaner should be drained and allowed to settle at least two or three days to remove the dirt. There should be enough clean oil on hand to refill the cleaner immediately to prevent loss of service. In cases where the pipe lines have exceptionally high dust loadings, it may be necessary to drain and settle the oil as often as once a week; in other cases, it may not be necessary more than once a year. To determine when it is necessary to drain the oil, one may judge from its appearance in the gauge glass or by taking a sample of oil from the gauge glass and letting it settle in a glass jar. The oil in the gauge glass should be drained first to get a fresh sample of the circulating oil.

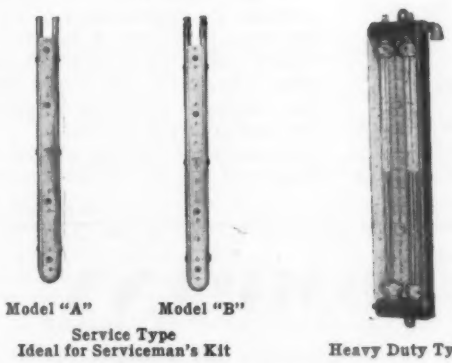
To blow out the dirty oil, open the valve to the desired settling tank and then open the drain valve slowly. The gas pressure will force the dirty oil out of the cleaner. If an excessive amount of dirt has accumulated in the cleaner, it may be necessary to blow high pressure gas back through the drain line to loosen the caked mud around the drain line opening, or if this does not work, to vent the cleaner, remove the clean-out cover and remove the accumulation with a shovel. It should be noted that the blow-down line opens from a point about two inches above the extreme bottom of the cleaner. After all oil and dirt are removed, the cleaner should be filled again to the proper level, with due regard for the initial absorption, and placed in operation again.

The oil type gas scrubbers are rated such that oil losses are held within reasonably low limits. In determining the proper size scrubber to use, the gauge pressure and gas flow in cubic feet per hour must be estimated or known. Blaw-Knox gas cleaners are made in the following sizes, referring to diameter: 24″, 30″, 36″, 48″, 60″, and 72″. In addition, there are two sizes classified as the "K Series Units", that is the K15-600 and K26-600. These are A.S.M.E. code constructed for 600 p.s.i. working pressure. The larger units are built for each particular job and may be obtained for maximum working pressures up to and beyond 1000 pounds gauge, as may be desired.

Selection of size should be based on the maximum peak hourly rate of gas passage, at the expected operating pressure. Where total gas through-put exceeds the capacity of one unit, two or more units may be installed in parallel.

NORWALK MANOMETERS

For Water, Mercury, Oil or Glycerine



Model "A" Service Type Ideal for Serviceman's Kit

Model "B"

Heavy Duty Type

For pressure or vacuum use. Made in all sizes and types. Service Type has unbreakable tubing and will stand abuse. Send for bulletin 3100M for complete data and prices.

NORWALK VALVE COMPANY

South Norwalk, Conn.

Manufacturers of Norwalk-Connelly Regulators since 1878

SULFUR-FREE GAS

AT LOWEST COST

WITH IRON SPONGE

Iron Sponge is a concentrated purification material that operates with high efficiency at high or low pressures, has excellent capacity and activity, gives long service between foulings and is simply and quickly regenerated. This is why Iron Sponge has been preferred for H_2S removal for over 75 years.

CONNELLY, Inc.

3154 S. California Ave., Chicago 8, Ill.
Elizabeth, N. J. • Los Angeles, Calif.

Independent Contractor

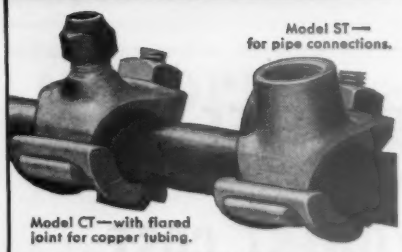
(Continued from page 18)

dangerously high that fastens negligence on the defendant (gas company). . . . It is conceded that the defendant (gas company) had the right to place and maintain its gas line and shut-off box in the parkway, and that the plaintiff had the right to walk along or across the parkway. The point of dispute is whether defendant maintained its shut-off box in such a way as to constitute a dangerous obstruction to a pedestrian crossing the parkway. . . . Defendant (gas company) had the right to locate the shut-off box where it did, but in doing so it was required to use ordinary care to keep the sidewalk and parkway reasonably safe for travel."

Quick easy way

TO MAKE GAS AND WATER CONNECTIONS

FOR REFRIGERATORS, LAUNDRIES, WATER-HEATERS, ETC.



Model ST—for pipe connections.

Model CT—with flared joint for copper tubing.

SKINNER-SEAL SADDLE TEE—for making gas and water connections. No pipe cutting or threading. Quick. Easy. Cuts costs. For gas refrigerators, home laundries, heaters, etc. Write for circular.

Approved by Underwriters' Laboratories, Inc.

M. B. SKINNER CO.
SOUTH BEND, 21, IND., U. S. A.

$40,000 Damages Too High

Occasionally a higher court will reduce damages awarded by a jury.

For example, in Checketts v. Covey Gas Co., 220 Pac. (2d) 682, it was shown that parents sued the gas company to recover damages for the death of their son Gary (then in his ninth year) who was killed in a collision with a truck owned and operated in the business of the company. The testimony showed that the son had alighted from a school bus and as he attempted to cross the highway, he was struck by the truck. The jury returned a verdict against the company for $40,000.00.

It is interesting to observe that the higher court held that the $40,000.00 damage allowance was too high and said:

"We are mindful of the rule that the amount of damages is primarily for the jury to determine, and that its verdict will not be disturbed except where abuse of its discretion clearly appears. . . . In this case we think the verdict excessive. . . . Accordingly the cause is remanded granting a new trial unless within 30 days the plaintiffs file a written consent to the reduction of the verdict and acceptance of judgment in the amount of $20,000."

For comparison, see the late case of Green, 48 Atl. (2d) 390.

In this case the higher court approved a jury's allowance of $85,000.00 damages for injuries to an occupant of a passenger automobile caused by negligence of a truck driver.

Driver Watches Girl in Shorts

According to a recent higher court a driver of a truck who fails to *carefully* safeguard children is negligent, and the gas company is responsible for injuries.

For illustration, in Georgia Gas Co. v. Fowler, 49 S. E. (2d) 550, the testimony showed facts, as follows: A boy named Fowler was injured when a motor truck owned by the gas company collided with another truck. Fowler was severely injured and sued the gas company for damages.

During the trial two witnesses testified that the driver of the gas truck was watching a woman dressed in shorts on the side of the street at the time of the accident, instead of looking out in front on the street where he was traveling.

In view of this testimony the higher court held the gas company liable in $16,500 damages to Fowler.

This court held that a truck driver who does *not* keep careful watch for children is negligent, and his employer is liable for resultant injuries.

Cochran Appointed Supervisor Rocky Mountain Area

C. R. Zeskey, Kansas City district sales manager for Rockwell Manufacturing Co. has announced the appointment of Orville Cochran as supervisor of gas products and Nordstrom valves in the Rocky Mountain area.

Mr. Cochran has been affiliated with Rockwell for over twenty-five years.

Blaw-Knox Expands Services In Tulsa Area

Chemical Plants Division of Blaw-Knox Company has announced the expansion of its operations at Tulsa, Oklahoma, to include complete plant engineering and construction services for the petroleum, gas, chemical, and process industries of the southwest.

At the same time, the division announced the appointment of Harold V. Williams, formerly of the Blaw-Knox Chicago office, as manager of the Tulsa office. Charles B. Barry was appointed chief engineer in charge of process design and contract execution.

As a result of the expansion, the Tulsa staff will include 50 engineers.

CRUSE-KEMPER COMPANY

AMBLER, PENNA.

MORE THAN FORTY-EIGHT YEARS OF SOUND

STEEL PLATE CONSTRUCTION

GAS HOLDERS **PURIFIERS**

Gas Holder Repairs **Gas Holder Inspection**

Mississippi River Asks FPC OK For More Lines in Texas

Mississippi River Fuel Corp., St. Louis, has filed an application with the Federal Power Commission seeking authorization to construct additional natural gas facilities, including approximately 98 miles of feeder pipe line, in Louisiana and Texas to enable it to draw upon two additional sources of natural gas.

The proposed 98-mile 18 and 16-inch feeder line would extend from the California Co. plant in Lincoln Parish, La., to Woodlawn gas field in Harrison County, Texas, with an 11-mile, 10-inch lateral running southerly to the Waskom field, also in Harrison County.

Estimated cost is $5,135,000.

Temporary Authorization Won For NY-Penna Line

The Federal Power Commission has granted temporary authorization to New York State Natural Gas Corp., of New York City, for the construction and operation of a 39-mile natural gas pipe line in Pennsylvania and New York.

The 20-inch line, which the company said will help it meet increasing demands of present customers, will extend from New York State Natural's State Line compressing station in Potter County, Pa., to the boundary line between Livingston and Monroe Counties, N. Y. The new line will parallel an existing line.

Estimated cost of the construction is $2,093,700.

Classified

FOR SALE

Surplus Meter Charts

65,000 in original containers M-250-50 inch and 250# pressure range 24 hour Wescott Orifice Meter Charts. Any reasonable offer will be considered. South Penn Natural Gas Co., Union Trust Bldg., Parkersburg, W. Va.

GAS ENGINEER

For consulting organization in New York. Must be graduate engineer, be up to date technically, have 5 to 10 years experience preferably with natural gas operating utility, and be qualified to make economic, operating and planning analyses. Salary range in accordance with qualifications. Box 232, c/o American Gas Journal Inc., 205 E. 42nd St., New York City 17, N. Y.

CHARLES R. BELLAMY

NATURAL GAS—MANUFACTURED GAS AND MIXED GAS PROBLEMS

44 Prospect Ave. Montclair, N. J.

Phone—Montclair 2-3692

LP-GAS ENGINEERING & CONTRACTING

More than 70 Peacock Designed Plants prove . . .

"There's No Substitute For Experience"

PAUL E. PEACOCK, JR.

Box 268, Westfield, N. J. Westfield 2-6258

E. Holley Poe & Associates

(ROBERT M. POE)

Natural Gas Consultants

Venezuelan Research & Development Corp.

70 PINE ST. NEW YORK 5, N. Y.

CONVERSIONS AND SURVEYS, Inc.

Gas Conversion Specialists

Conversion without Confusion

90 BROAD STREET NEW YORK 4, N. Y.

HAROLD MOORE

Consulting Engineer

SPECIALIST IN PLANT CONVERSIONS TO HIBTU OIL GAS

30 Vesey St., New York 7, N. Y. Phone WOrth 4-3473

COAL AND COKE HANDLING

Complete engineering and installation service for coal and coke handling, screening, crushing, skip hoists and storage bins, including alterations to existing conveying and screening plants.

ROBINS ENGINEERS DIVISION

HEWITT-ROBINS INCORPORATED

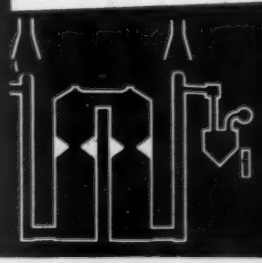
157 Chambers Street New York 7, N.Y.

SEMET-SOLVAY

ENGINEERING DIVISION

Allied Chemical & Dye Corporation

40 RECTOR STREET · NEW YORK 6, N.Y.



- BLUE GAS PLANTS
- WATER GAS MACHINES
- WASHER COOLERS
- CHARGING MACHINES
- GAS PURIFIERS
- CONDENSERS
- WASTE HEAT BOILERS
- PRODUCER GAS PLANTS
- HIGH BTU OIL GAS PLANTS

LP-GAS INSTALLATIONS

Contracting Consulting

LP-GAS SPECIALISTS

H. EMERSON THOMAS AND ASSOCIATES

Box 270, Westfield, N. J. Westfield 2-2800

Robertshaw-Fulton Opens New West Coast Laboratory

The West Coast Research and Development Laboratory of the Robertshaw-Fulton Controls Co. has moved its equipment to the new laboratory building recently completed near the Los Angeles International Airport.

The initial building, containing over 12,000 square feet, is of modern fireproof construction. Located on an acre of ground, the current facilities are so arranged as to permit future expansion to double the present floor area.

The laboratory is specially equipped for basic research, as well as the development of all types of controls and devices. The individual sections devoted to research, development, drafting and testing, each have their separate locations to facilitate holding conferences within each group. A centrally located library also serves as meeting room for staff conferences and seminars.

The model shop is well equipped with every type of machine required for precision model making.

A modern test kitchen permits installation and operation of various domestic appliances, together with their accessories, under conditions duplicating actual use in the home.

According to H. W. Geyer, director of the new laboratory, the staff is presently being increased and will continue to grow in number, representing the major branches of engineering, the physical sciences, and the skilled crafts.

CONVENTION CALENDAR

September

4-6 PCGA Convention, Fairmont Hotel, San Francisco.

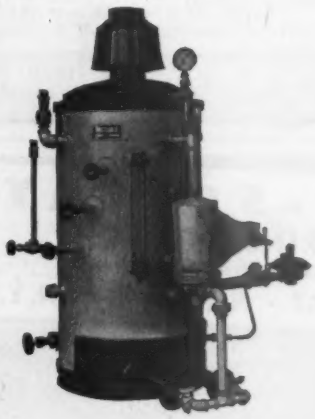
7 New Jersey Gas Association, Springlake, N. J.

13-14 Mid-west Gas Association, Ames, Iowa

October

15-17 AGA Annual Convention, St. Louis.

LATTNER
INDUSTRIAL GAS BOILERS
1 H.P to 45 H.P.



Vertical and horizontal types available.

P. M. LATTNER MFG. CO.
CEDAR RAPIDS, IOWA

New Aluminum Plant Orders Cooper-Bessemer Engines

The Cooper-Bessemer Corp. has announced it has received an engine contract to build 40 of its largest supercharged gas engines for Reynolds Metals new aluminum reduction plant to be located near Corpus Christi, Texas. This is the biggest single commercial engine order ever to be received by this 118-year-old engine builder and calls for the fast construction. Engine deliveries are to start in August and are to be completed by January of 1952, according to Stanley E. Johnson, Cooper-Bessemer's vice-president and general sales manager.

"The gas engines to be furnished by Cooper-Bessemer are to be supercharged and spark ignited, developing 3700 horsepower at 327 rpm and at 135 pounds bmep," explained Mr. Johnson. Natural gas for fuel will be furnished from nearby independent fields. When the completed power plant is in full operation, natural gas will be drawn at the rate of 48 million cu. ft. a day.

The Reliable Shut-Off for Street Mains

THE GOODMAN STOPPER

Now has the "Z" handle for easy manipulation. When locked in place it holds. Stopper cannot slip. Gas cannot pass. Adjusted in 30 seconds.

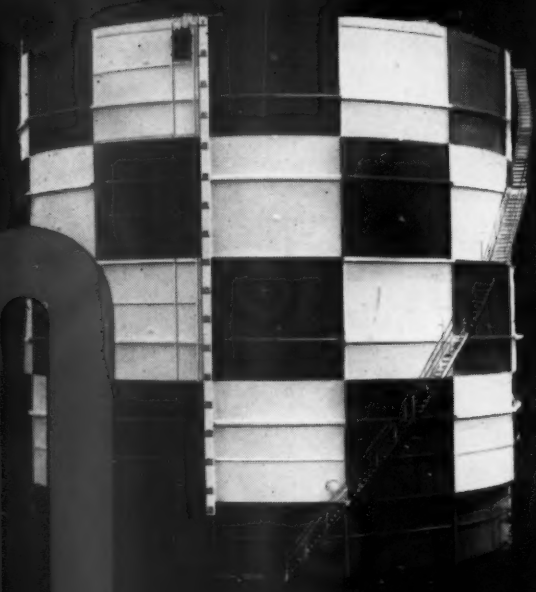
Ask for circulars on this and other distribution equipment.

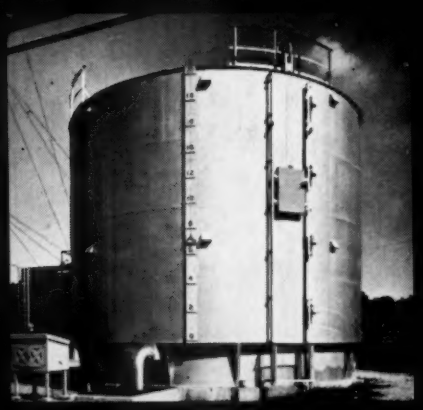
Nearly a half century of service to the Gas Industry.

Safety Gas Main Stopper Co.
523 Atlantic Avenue, Brooklyn, New York

INDEX TO ADVERTISERS

American Meter Co. 4
Blaw-Knox Div. 1
Cast Iron Pipe Research Association, The .. 6-7
Connolly Inc. 44
Cooper-Bessemer Corp., The 2
Cruse-Kemper 46
Empire Stove Co. 5
Gas Construction and Service Co., Inc. 44
Gas Machinery Co., The 41
Gas Purifying Materials Co., Inc. 43
General American Transportation Corp. Inside Back Cover
Lattner Mfg. Co., P. M. 48
Norwalk Valve Co. 44
Pollard Co., Joseph G. 44
Reynolds Gas Regulator Co. 39
Rockwell Manufacturing Co. ..... Front Cover
Inside Front Cover
Safety Gas Main Stopper Co. 48
Semet Solvay Engineering Division, Allied Chem. & Dye Corp. 47
Servel Inc. 8
Skinner Co., M. B. 46
Stewart-Warner Corp. 43
Sprague Meter Co. ..... Back Cover



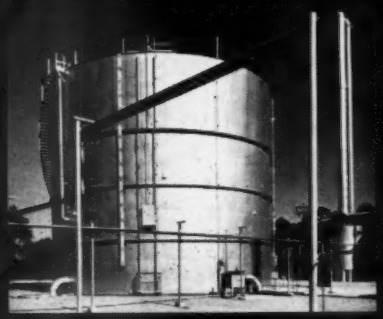


50

Wiggins Gasholder

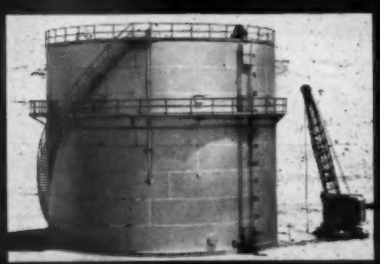
installations
in the 3 years
since introduction!

no doubt about it . . . simplified Wiggins design is a better way to store industrial and chemical process gases

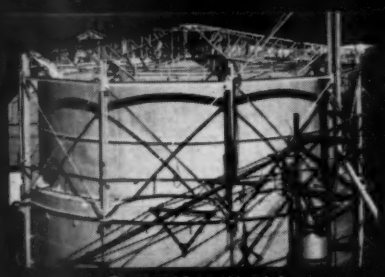


it's the **only** gasholder that uses

NO WATER TAR GREASE



it's the **only** gasholder with **AN ABSOLUTELY DRY, FRICTIONLESS SEAL**



Converted from old style!

it's the **only** gasholder that assures

NO WEATHER WORRIES
OPERATING COSTS
MAINTENANCE PROBLEMS

Operates at pressures up to 20" of water. Gas tightness and impermeability of Wiggins dry seal proved in 15 years' service under actual operating conditions. Ask about converting your present gasholders to Wiggins principle.

WRITE FOR NEW BULLETIN WG-22
OR REFER TO BUILDER'S COMMITTEE REPORT (May, 1951), AMERICAN GAS ASSOCIATION

WIGGINS VAPOR SEALS
GENERAL AMERICAN
TRADE MARK

GENERAL AMERICAN
Transportation Corporation

General Sales Office: 135 So. La Salle St., Chicago 90, Illinois

Branch Offices: Buffalo • Cleveland • Dallas • Houston • Los Angeles • New Orleans • New York • Pittsburgh • San Francisco • Seattle • St. Louis • Tulsa • Washington • Export Dept.: 10 East 49th Street, New York 17, New York • Plants: Birmingham, Ala.—East Chicago, Ind.—Sharon, Pa.

FOR TOP PERFORMANCE

SPECIFY— **SPRAGUE METERS**

Engineered for dependable long time service, durable aluminum and cast iron cases protect built-in accuracy. You can rely on Sprague Meters, they are built to last!

THE SPRAGUE METER COMPANY

MAIN OFFICE and PLANT — BRIDGEPORT 4, CONNECTICUT

BRANCHES: DAVENPORT, IOWA, HOUSTON, TEXAS, LOS ANGELES, CALIF., SAN FRANCISCO, CALIF.